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BY J. E. MEGSON AND H. S. JONES.

CLOSURE OF COLUMBIA RIVER CHANNEL.

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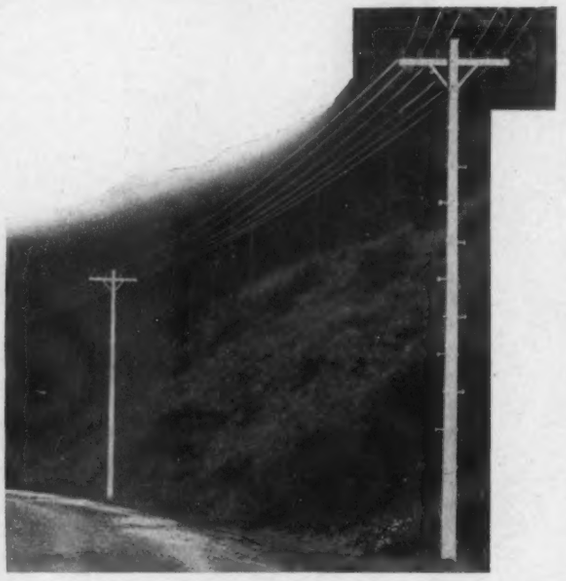

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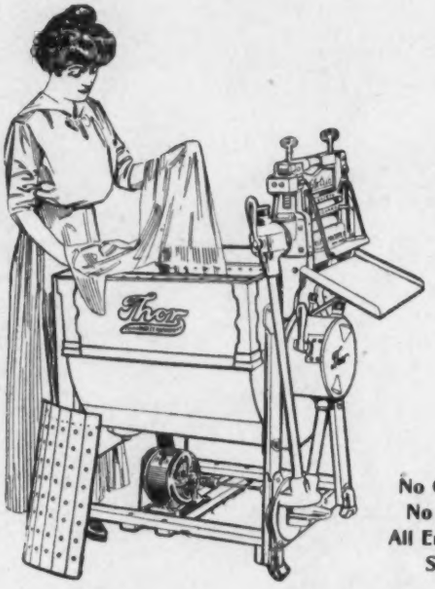

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VOLUME XXXVI SAN FRANCISCO, JANUARY 29, 1916 NUMBER 5

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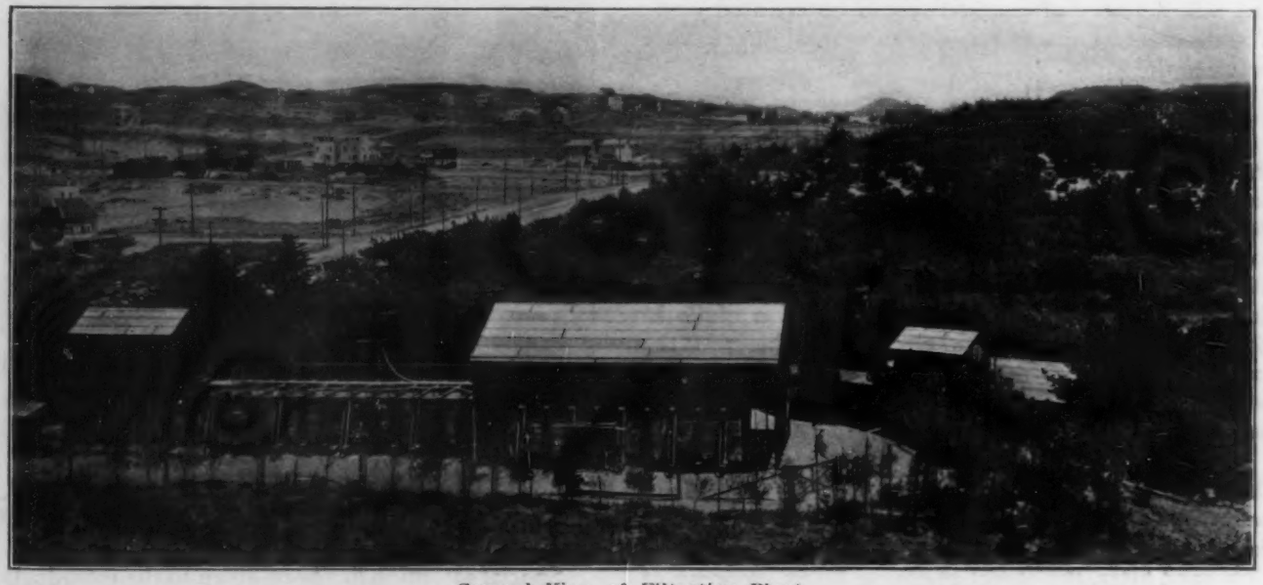
P. P. I. E. AUXILIARY WATER SUPPLY

BY E. C. EATON.

(This interesting account of developing, pumping and treating water from sandy soil contains several valuable suggestions for similar undertakings. It includes a description of an economical method of driving such wells and of water purification. The author was superintendent of the filtration plant described.—The Editor.)

The estimated water requirements for the Panama-Pacific International Exposition, including that for drinking purposes, watering lawns and filling fountains, was 1,500,000 gallons for an average day, and 2,100,000 gallons for a day of exceptionally large attendance. It was at first intended to obtain this supply from the Spring Valley Water Company by means of a tap at Van Ness avenue, which would have necessitated the expenditure of a large sum to increase the size of the water company's mains in this district. At a late date, after the distribution system had been installed in the grounds, the water company found that it could not bring into the city a sufficient quantity of water to supply both the increased needs of the city and the Exposition during the year 1915 and for this reason the exposition looked for an independent supply.

The federal government operates a filtration and pumping plant having a capacity of 2,000,000 gallons per day, which supplies the military reservation with drinking and irrigation water. This supply is taken from Lobos Creek, filtered, and pumped to a reservoir of 6,000,000 gallons capacity. The daily capacity of this plant is from 400,000 to 800,000 gallons in excess of the government's requirements, and arrangements were therefore made to purchase this excess for exposition purposes, and for the use of one-half of their reservoir, the excess water to be supplied to the exposition half by means of an overflow weir cut in the wall dividing the revervoir into two parts. This gave the exposition a reservoir of 3,000,000 gallons capacity, and a gravity pipe line was laid from this reservoir to the exposition grounds, a distance of 5000 ft.



General View of Filtration Plant.

To meet the excess water required, a source of supply of nominal capacity 1,500,000 per day was developed in the Richmond District about five miles from the exposition grounds, and known as "The Filtration Plant." This plant consists of: six deep wells and a sump from which water is pumped to a filtration and treating plant, and a main pumping plant supplying water to the Presidio reservoir.

Sources of Supply.

Owing to the nature of the soil in the Richmond district, which is a fine uniform beach sand having an effective size of 0.18 m/m and a uniformity co-efficient of 1.5 and to the reputed difficulties in eliminating sand from deep wells, it was at first decided to try a sump as a source of supply. A sump 200 ft. long by 14 ft. wide by 30 ft. deep was constructed of 4 in. timber piling and provided with 100 infiltration screens over openings cut in the timbers about 4 ft. above the bottom. The elevation of the ground surface at the sump is 7.5 city datum. On test only 165 g.p.m. or 240,000 g.p.d. is available from the sump as a continuous supply.

A test well was next sunk in the vicinity of Forty-seventh avenue and Fulton street, just outside of Golden Gate Park limits. In September, 1914, three 12-hour tests and one 24-hour test were made which indicated that 186 g.p.m. could safely be drawn from this well, with very little sand.

On the strength of this showing, four other wells were drilled in the vicinity on leased property. The wells are about 200 ft. apart and are all within a space of 650 feet square. The wells were all sunk until the clay stratum was encountered at depths ranging from 75 to 85 ft.

Owing to mutual interference it was estimated that with the five wells working simultaneously 2¾ times the safe delivery of one well could be counted upon. The decrease of course was due to mutual interference between the wells.

Filtration Plant.

Tests made from ground water in existing wells in this district showed a potable water but chemical and bacteriological analyses indicated that the water should be carefully watched and for this reason it was decided to build an up to date filtration plant. The plant is of the type known as the "rapid sand filter" and was designed by the writer, under the direction of G. L. Bayley, chief mechanical and electrical engineer for the exposition. The plans were later submitted to Professor Charles Gilman Hyde, consulting sanitary engineer, for his approval.

This type of filter employs a high rate of filtration through a special grade of sand, the rate in general use being not over 125,000,000 per acre sand surface per day as against 2,500,000 gallons as employed in the slow sand filter, the object of course being economy of space. The sand used had an effective size of .35 m/m and a uniformity coefficient of 1.5, and is somewhat finer than that in general use, as removal of bacteria was the main object.

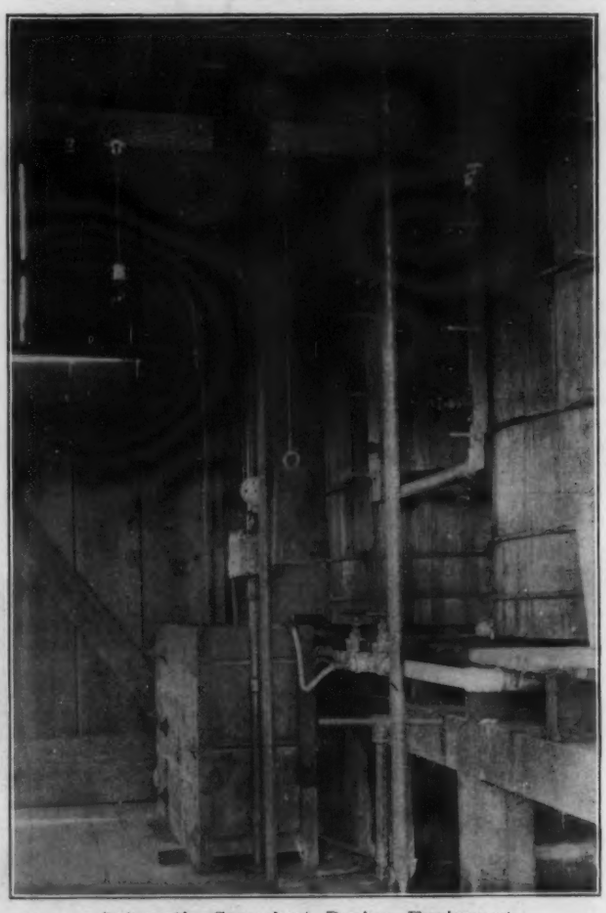
The filters are three in number, each having an area of 183 sq. ft. and a capacity of 500,000 g.p.d. each. The depth of the sand is 26 in., under which is about 18 in. of graded gravel over the strainer system.

The strainer system consists of a specially tapered header from which 2½ in. lateral pipes, spaced 6 in. centers, lie horizontally on the bottom of the filter. These laterals have 5/16 in. holes drilled on the under side, 3 in. centers.

Owing to the temporary nature of the plant a timber flume structure was used throughout.

The rapid sand filter depends for its efficiency of filtration upon a gelatinous blanket, or "floc," being artificially formed upon the surface of the sand by means of a coagulant such as aluminum sulphate, this floc preventing the passage of impurities through it. Due to the high rate of filtration, the sand requires washing every eight to twenty-four hours, for which special provision has to be made.

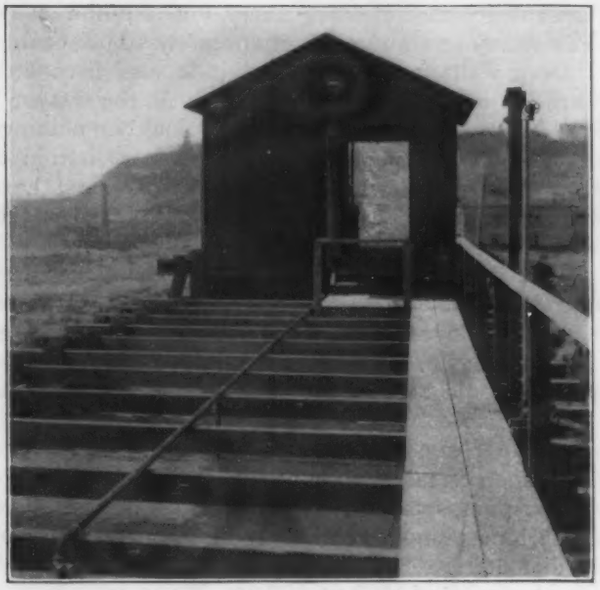
The method of washing used in this plant has been the use of a high velocity rate of washwater through the sand, the water combining the operations of stirring and cleansing the sand. This has been entirely satisfactory and has resulted in less time taken in washing, and a saving in water required to wash.



Automatic Coagulant Dosing Equipment.

Special attention has been given to the introduction of coagulant—aluminum sulphate. The floc, or aluminum hydrate is formed by a chemical action in which aluminum sulphate is decomposed by the calcium carbonates contained in the water, forming calcium sulphate which is soluble, and aluminum hydrate which is insoluble. From 20 to 30 minutes are required for the formation of this floc and it is important that this period be allowed, in order to form the required gelatinous blanket on the filters. It is also important that, during the formation, it shall not be broken up.

In the exposition plant the water is discharged from the sump and wells into a measuring chamber from which it flows through a submerged orifice into a raw water reservoir consisting of a flume 64 ft. 0 in. long by 12 ft. 6 in. wide by 7 ft. 0 in. deep, at the far



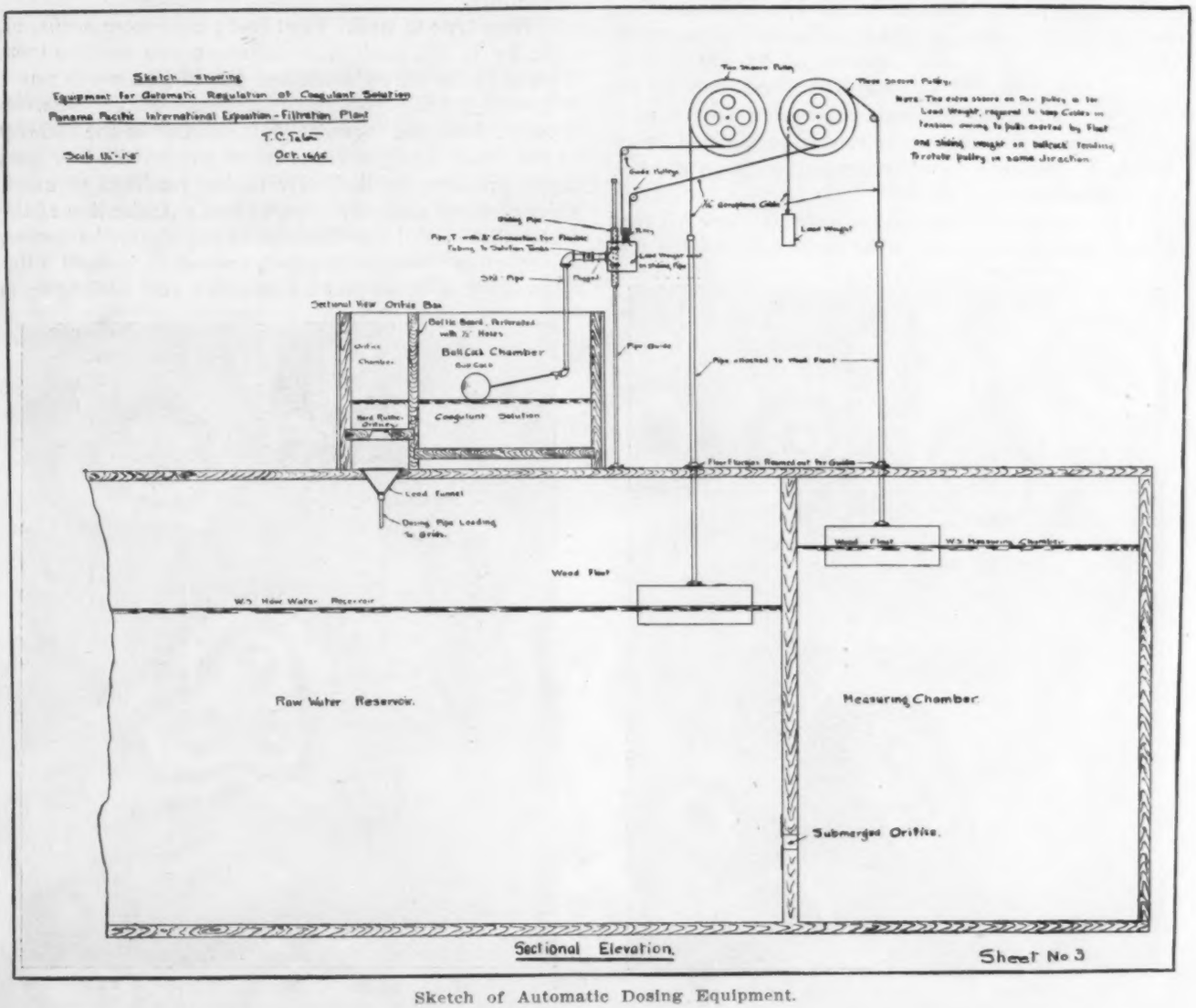
Coagulant Dosing Grids.

end of which the water is taken through the filters. The size and length of this flume is such that at the rated capacity of the plant 1,500,000 gallons per day, a period of 40 minutes will elapse before the water entering the measuring chamber will reach the filters.

The aluminum sulphate solution is mixed in tanks in a house over the measuring chamber and fed to the water through a pipe grid consisting of a ¾ in. pipe having ¼ in. holes on the under surface. These grids are connected by 1¼ in. pipe to the solution tanks through an orifice box located near the solution tanks. Several grids are supplied at points in the flume, at various distances from the end discharging into the filters, so that one may be chosen that will give the required period of time for coagulation.

An automatic dosing equipment has also been installed which, to the best of the writer's knowledge, is new. A sketch of this is attached.

The raw water is discharged from the wells into a measuring chamber separated by a bulkhead from the raw water flume (or coagulating basin). The water flows from this measuring chamber into the coagulating basin through a submerged orifice, the quantity of water flowing being therefore in proportion to the difference in water levels in the measuring chamber and coagulating basin. As the water level may vary somewhat in the coagulating basin some mechanism was required that would keep a head over the dosing



Sketch of Automatic Dosing Equipment.

orifices in the orifice box proportional to the difference in the water levels between the measuring chamber and coagulating basin. This was accomplished by having two floats, one in each chamber, each terminating in a rod, to the end of which was attached a 1/16 in. diameter aeroplane cable. Each float actuated a cast iron wheel to which was fastened a piece of cable running through a pulley attached to a ballcock. The action was that the ballcock mechanism would respond only to differences in water level in the measuring and coagulating chambers thus maintaining a height of solution over the orifices in proportion to the amount of water flowing.

After filtering, the water is given a treatment of liquid chlorine at the rate of 3 lb. per 1,000,000 gallons of water. This equipment was installed by the Electro-Bleaching Gas Company of New York and has been entirely satisfactory, requiring little attendance and representing a big advance over the older chloride of lime treatment.

Experience With Operation of System.

Sump. A vertical 3 in. centrifugal pump was installed in the sump, discharging through a 6 in. casing pipe to the measuring chamber of the filtration plant.

The sump has been found capable of delivering 165 g.p.h. continuously with the water drawn down to the suction of the pump, elevation minus 18. The sump, when full, has a storage capacity of 500,000 gallons, and has been valuable as a regulating medium for the plant, supplementing the main reservoir capacity, as at times of small demand water would be allowed to accumulate, available for emergencies such as days of heavy demand.

The removable infiltration screens were cleaned in June and were found to be somewhat rusted and gave evidence that cleaning every four months would increase the output of the sump possibly 10 per cent.

Deep wells. At an early date it was discovered that the results obtained from No. 1 well, the test well, were by no means indicative of what could be obtained from the other four wells. The only explanation of this is that a somewhat coarser material must have been encountered at No. 1 well than at the other locations.

To avoid the expense of taking out the deep well pump every time a well filled with sand, a small air lift was employed, consisting of a 1¼ in. discharge pipe and a ½ in. air pipe, this being the largest size pipe that could be inserted between the inside casing and the pump column. This proved to be satisfactory and would clean out a well in three hours, most of which time was taken up in preparing the equipment.

The pumps installed were vertical, 3-stage, deep well turbine pumps, 11 in. over all diameter, runners 8 in. diameter, rated at 250 g.p.m. under a total head of 75 ft. at a speed of 1500 r.p.m.

After nearly three months attempting to develop these wells it was decided to abandon them and experiments were made to determine a suitable perforation and a suitable filler between casings to eliminate the sand.

New type of well. First test plates were prepared, 8 in. by 12 in., each with different size perforations. Two of these were chosen and placed in a wood frame box with a trial mixture of sand and gravel between them. Above the topmost plate sand from the vicinity of the wells was placed, a cover put on the box, and water pressure applied. By taking readings of quantities of water and pressures, and an examination of the water discharged through the lower plate, the proper size perforation was decided upon and a sand filler chosen. This sand had an effective size of 0.42 m/m

Drilling Well No. 6—First Section.

Drilling Well No. 6, showing Water Jet Used.

and a uniformity coefficient of 2.18. It was accordingly decided to drill a new well using the sand filler and type of perforations thus obtained.

In order to allow for cleaning out the sand filler between the casings if it should become clogged up, a 3 in. space between the casings was allowed, thus making the inside casing 16 in. and the outer 22 in., instead of 16 in. and 20 in. employed in the first wells. The writer drilled this well in three days by using a simple hydraulic jet, instead of the regular well-drilling rig, at a cost of $3.89 per foot depth. As the contract price for the old type of well was $7.50 per foot and the difference in price of 20 in. and 22 in. casing is 10c per foot, probably the best price that could be obtained for a new well of this type would have been $7.60 per foot, thus representing a saving of nearly half of the contractor's price. This well is 60 ft. deep and on a 20 hour test gave the following results:

Discharge G.P.M.	Drawdown Feet.	G.P.M. per ft. Drawdown.
5	1.5	3.3
20	3.25	6.15
35	4.33	8.10
60	5.91	10.15
110	8.43	10.50
125	11.90	10.50
155	13.40	11.56
175	15.00	11.62
200	16.40	12.20

No sand whatever was noticeable in the discharged water.

A pump of the same type as those installed in the other wells was installed in this well and has been running continuously since May 28, 1915, when the well was drilled, with no trouble whatever. The success of this well resulted in a determination to overhaul wells Nos. 2, 3, 4 and 5 in a similar manner. As it was impossible to withdraw the old inner casing a new casing, 13½ in. diameter, was placed inside the well, leaving a 1 in. space between it and the old inner casing. This was filled with the same grade of sand as in the new well, and has been satisfactory, although not as good as for No. 6 well, owing to the thinness of the gravel layer, which is 1 in. instead of 3 in. A test of one of these reconstructed wells (No. 4) gave the following results:

Discharge G.P.M.	Drawdown Feet.	G.P.M. per ft. Drawdown.
10	3.75	2.67
49	6.92	7.07
92	12.08	7.62
140	17.33	8.07
202	23.83	8.45
243	27.60	8.80

City Installation.

In August, 1915, anticipating the possible heavy demands of September, permission was obtained from the City of San Francisco to use two wells in the vicinity of the plant, recently drilled by the city but not yet in use. These wells had purposely been driven 210 and 303 ft. deep to tap the lower water stratas, to obtain a purer water.

An analysis of water from these wells showed a low count so that it was not considered necessary to filter this water, but as a precautionary measure, a treatment of chlorine at the rate of 3 lb. per one million gallons was given. As the installation was an auxiliary one only, an air lift, made up of standard 4½ in. pipe with 1½ in. air pipe was installed in each of these wells, with 2½ in. air piping running from an 8 in. by 10 in. compressor 1700 ft. distant. The water is discharged into weir boxes, from which it flows by gravity through a 6 in. wire-wound wood pipe to the filtered water reservoir into which it discharges and receives a chlorine treatment before being pumped to the exposition.

With both wells running at the same time and a submergence of 67 per cent and 57 per cent respectively, 138 g.p.m. and 115 g.p.m. were discharged at 241 r.p.m. compressor speed.

With one well alone (No. 617) and 54 per cent submergence, 172 g.p.m. was discharged, and with No. 628 running alone, 220 g.p.m. were discharged with 61 per cent submergence at the same compressor speed.

A certain amount of fine sand was discharged for about five to ten minutes after first starting the pumps, after a shutdown, and on one occasion two yards were thrown by one of the wells in four hours. In all, the wells have been in use 660 hours, and have pumped 10,000,000 gallons of water, during which time a total of about five cubic yards has collected in the weir box.

Operation of Filtration Plant.

No serious trouble has been experienced with the filtration plant. At exactly the rating of the plant, 1,500,000 gallons per day, the filters operate automatically by means of the automatic controller, as shown on drawing.

Table No. 2.

Actual Quantities Pumped, and Cost of Water.

Month (1915).	Gals. from Exposition Wells.	Gals. from Exposition sump.	Gals from City Wells Nos. 617 and 628.	Total Gallons.	Average g.p.m. per deepwell pump.	Cost — Cents per 1000 gals.
March ...	9,889,710	233,100	.....	10,122,810	98	.....
April	14,193,360	3,559,440	.....	17,752,800	130	.....
May	14,335,520	3,168,180	.....	17,503,700	122	11.35
June	28,298,500	3,433,500	.....	31,732,400	157	5.65
July	30,820,400	2,042,500	.....	32,862,900	142	7.42
Aug.	31,174,000	3,505,600	1,085,300	35,764,900	129	6.37
Sept.	24,795,050	2,867,200	3,920,350	31,582,600	131	6.95
Oct.	18,181,030	2,167,720	1,168,850	21,517,600	132	8.47
Nov.	4,547,230	4,108,600	3,856,670	12,512,500	101	8.75

Note:—Costs of water include power, oil, sulphate, perators, superintendence and repairs to pumps, but do not include any interest or depreciation on investment.

Costs of water. Table No. 2 gives actual quantities of water handled by the filtration plant together with the average gallons per minute per well and the cost in cents per 1000 gallons. The power rate was 0.6 cents per kw.-hr. plus a monthly maximum demand charge of $2 per kw. maximum half hour demand.

Due to the fact that the reservoir capacity is small the plant was called upon for varying quantities of water daily and the best advantage could not be taken of this method of charging. The rate has been equivalent to a charge of 1¼ cents per kw.-hr. without maximum demand. The costs of water include power, oil, sulphate, operators and superintendence, and repairs to deep well pumps but does not include any interest or depreciation on the plant. The greatest item of cost has been the power required to pump to the reservoir a static head of 365 ft. through 19,300 ft. of 12 in. pipe line. The itemized costs for the month of June are as follows:

Cost of Pumping from Deep Wells, per 1000 Gals.

	Cents
Power	0.956
Operators and superintendence	0.607
Repairs to pumps	0.047
Oil, grease, waste, etc	0.017
	1.627

Cost of Filtering and Treating Water, per 1000 Gals.

	Cents
Sulphate of Alumina	0.250
Chlorine	0.056
Washwater	0.045
Operators and superintendence	0.623
	0.974

Cost of Pumping to Main Reservoir, per 1000 Gals.

	Cents
Power	3.410
Operators and superintendence	0.631
Oil, waste and miscellaneous	0.004
	4.045

Total—6.646 per 1000 gals.

Costs of plant. The filtration plant, including all structures and connecting piping, also the pump houses and foundations for pumps and motors at the deep wells and sump, was installed under contract, the price being $14,575. This did not include sand and gravel, but included the placing of same. The filter sand, 0.35 m/m effective size, came from the bay shore about 60 miles south of San Francisco, and cost $2.75 per yd. delivered at the plant in carload lots. The graded gravel cost $2.50 per yd. delivered.

Wells. The first five wells were drilled under contract for $7.50 per foot. The sixth well, drilled by the hydraulic process, cost $3.89 per foot. The itemized costs of this well are as follows:

Double casing, 12 gauge	$2.65
Gravel blanket	.09
Cement plug	.01
Labor	1.14
Total per foot	$3.89

Pumps. The three main pumps, which are 5-stage, 6 in. turbine pumps, speed 1600 r.p.m., 500 g.p.m. each at 220 lb. pressure, cost $600 each, with no erection. The three inch vertical centrifugal pump, 1250 r.p.m., 250 g.p.m., 85 ft. head, cost $195 erected. The five 11 in. deep well pumps, 70 ft. long each, rated at 250 g.p.m. under 75 ft. lift, speed 1500 r.p.m., cost $547 each in place. The 10 in. horizontal centrifugal pump, 2800 g.p.m., at 35 ft. head, 525 r.p.m., cost $233 not erected.

Efficiencies of Pumping Equipment.

Tests were made on the main pumps, deep well turbine pumps, vertical centrifugal pumps and air lift after they had been in service eight months. The tests were made with a test gauge and weir box, the power being measured with a stop watch on the integrating meter.

Main Pump.—Rating. 6 in., 5-stage, horizontal turbine pump, 500 g.p.m. at 220 lb. per sq. in. pressure, 1600 r.p.m. belted to 125 h.p. induction motor:

Motor efficiency assumed.... 85 per cent
Belt efficiency assumed..... 92 per cent
Test: Head = 367.7 ft.
Q = 642 g.p.m.
Theoretical power required = 59.5 h.p.
Actual motor input = 157.5 h.p.
Pump efficiency ..... 48.6 per cent
Wire to water efficiency.. 37.8 per cent

Deep well pump.—Rating. 11 in., 3-stage, vertical turbine pump, 250 g.p.m., 75 ft. head, 1500 r.p.m., belted to 15 h.p. induction motor.

Motor efficiency assumed.... 85 per cent
Belt efficiency assumed.... 88 per cent (quarter turn.)
Test. Head = 55 ft.
Speed = 1175 r.p.m.
Q = 192 g.p.m.
Theoretical power required = 2.67 h.p.
Actual motor input = 12.65 h.p.
Pump efficiency ..... 28.2 per cent
Wire to water efficiency.. 21.1 per cent

Sump pump.—Rating. 3 in., single-stage, vertical centrifugal pump, 250 g.p.m., 85 ft. head, 1250 r.p.m., belted to 20 h.p. induction motor.

Motor efficiency assumed.. 85 per cent
Belt efficiency assumed.... 88 per cent
Test. Head = 85.25 ft.
Speed = 1155 r.p.m.
Q = 192 g.p.m.
Theoretical power required = 4.15 h.p.
Actual motor input = 12.65 h.p.
Pump efficiency ..... 37 per cent
Wire to water efficiency.... 28 per cent

Air Lift in City Well No. 628.—Rating. 4½ in. air lift with 1½ in. air pipe. Air pipe passed through center of discharge pipe.

Air compressor 8 in. by 10 in., Sullivan, belted to 35 h.p. induction motor. Receiver at compressor. Air line 1700 ft.; 2½ in. W. I. pipe to wells.

Test. Compressor speed = 241 r.p.m.
Q = 220 g.p.m.
Submergence = 61 per cent.
Compressor displacement, cu. ft. air per gal of water = 0.637.
Pump efficiency .....24 per cent
Wire to water efficiency... 18 per cent

Note:—Compressor overspeeded 60 per cent above rating. Efficiency includes losses in 1700 ft. of air pipe.

Interference Between Wells.

The interference is expressed as the percentage reduction in yield per well below that of a single well uninfluenced by others.

The wells are located approximately 200 ft. apart.

After No. 1 well was drilled and before drilling the other wells the assumption was made that 186 g.p.m. was a safe delivery from each well and that with all five wells running at the same time, 2¾ times the yield of one well, or 102 g.p.m. per well, could be counted on, giving an interference of 45 per cent. The results obtained are somewhat better than this. The averages for the month, together with the average gallons per minute per foot drawdown in the water surface are as follows:

Month 1915.	Average G.P.M. per well.	Average G.P.M. per ft. drawdown.
March	98	7.85
April	130	14.80
May	122	12.36
June	157	13.30
July	142	8.04
August	129	6.35
September	131	6.60
October	132	6.70
November	101	5.47
Average	127	9.03

The average for the nine months is 172 g.p.m. per well with a drawdown of 9.03 per foot, or 14.1 ft.

Referring to the test of No. 1 well, for a drawdown of 14 ft. we should expect 230 g.p.m., giving an interference of about 45 per cent. This result is not correct, as No. 1 well alone would not give as good a delivery throughout the season as that shown by the test of September, 1914, but will give the results to be expected from a group of wells in actual operation, continuously, as compared with a single well tested under the best conditions.

During the month of November, when the plant was running only 16 hours a day, measurements were taken to determine the effect of operating the exposition wells on the water levels on wells in the vicinity. The water levels were measured after all wells had been shut down for eight hours, and again after wells were in operation for eight hours. The average of all the measurements is as follows:

	Feet
Exposition Wells Nos. 3 and 5, water drawn down 17 ft.—drop in Sutro Well	0.52
Exposition Well No. 3, drawn down 19 ft—drop in Sutro Well	0.15
City Well No. 617, drawn down 42 ft.—drop in City Well No. 628	3.90
City Wells Nos. 617 and 628, drawn down 35 ft. and 41 ft. respectively—drop in City Well No. 616	0.18

Estimate of Quantity of Water Available in Richmond District.

From the observations made during the operating period an estimate may be made of the quantity of water available in this district. The test borings made, together with the depths of the six deep wells which were put down, indicate that the clay strata rises towards the surface as we go in a southerly direction and may indicate the presence of a divide in the underground waters about midway through the park. This would also account for the small amount of water, relative to its size, obtainable from the sump and would also account for the fact that the water flows into the sump in greater quantities at the north end than at the south end. The results show that during the months of heavy pumpage, July, August and September, more water was withdrawn than the daily flow. The figures indicate that with the present arrangement of these wells about 700,000 gallons per day can safely be drawn from the area affected by the wells. The area tributary to these wells is probably 1½ square miles, giving a safe yield for this district of 465,000 gallons per day per square mile, or 9¾ in. annually over the area.

Conclusions.

The average daily rate of pumping 640,000 g.p.d., has been close to the average daily quantity flowing past the area affected, 710,000 g.p.d., and is equivalent to less than 10 in. rainfall over the area if this rate were continued through the year, agreeing closely with the value obtained for Lobos Creek area, of 10.7 in.

A type of well having the size perforation and gravel filler best suited to the particular district, as chosen by test, can be drilled at a cost under $4 per ft. up to 100 ft. depth, and will entirely eliminate the sand from the well. A 3 in. space should be allowed of this material.

A single well of this type will safely discharge, continuously, over 200 g.p.m. with a drawdown of less than 17 ft. in the water surface, or, a group of wells, spaced 200 ft. apart, can be counted on for over 155 g.p.m. with the same drawdown.

The design, construction and operation of the system was carried out, under the direction of G. L. Bayley, chief mechanical and electrical engineer, P. P. I. E., by the writer

Interior of Well-Lighted Store.

EFFECTIVE LIGHTING OF A RETAIL STORE.

"Trade follows light" is a slogan which is well exemplified in practice in the case of a retail haberdashery store on Market street, San Francisco, where the installation of proper illumination was followed by a fifty per cent increase in business. The accompanying pictures of Hansen & Elrick's store tell their own story of the effectiveness of light, properly placed, in aiding the sale of goods.

The ample lighting of the entrance is such as to attract favorable attention from the pedestrian. This is secured by means of a 1000 watt type C Mazda lamp in a Holophane Realite suspended from the arched entrance way and a 60 watt lamp with flange and bowl reflector over the door, together with 44 lamps placed in the double-story window display. These latter are 100 watt type C units in Holophane prismatic window reflectors.

The firm name appears in an arched sign over the entrance. The 15 in. letters are of opal glass with metal background, the letters being illuminated by twenty-five 40 watt lamps in Holophane metal reflectors placed 30 in. back of the sign.

Further interest is induced by the brilliant lighting of the interior which brings out the attractive features of the stock displayed. General illumination is obtained from two 300 watt type C lamps in Realite reflectors and thirteen 100 watt units strategically placed on the ceiling in Holophane prismatic reflectors. What would otherwise be waste wall space is utilized by nine display cases near the ceiling, each fitted with three clear prismatic reflectors carrying 40 watt lamps.

The bookkeeping department and stock rooms on the second floor are well lighted by means of twelve 60 watt lamps in prismatic reflectors on the ceiling.

This installation typifies how the lighting expert can assist in making the retail store attractive to the shopper. Good lighting helps sales, as it not only calls attention to goods that might otherwise be overlooked, but it also satisfies the consumer as to the quality of the articles purchased.

Illuminated Store Exterior.

DIESEL ENGINE PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

Modern Engines.

(Continued.)

The Allis-Chalmers Manufacturing Company of Milwaukee are manufacturing a horizontal oil engine, shown in Fig. 18. This engine is designed under the Lietzenmayer patents, using the open type of fuel nozzle of that name. In this type of nozzle, shown in Fig. 19, the fuel is delivered by the pump into a

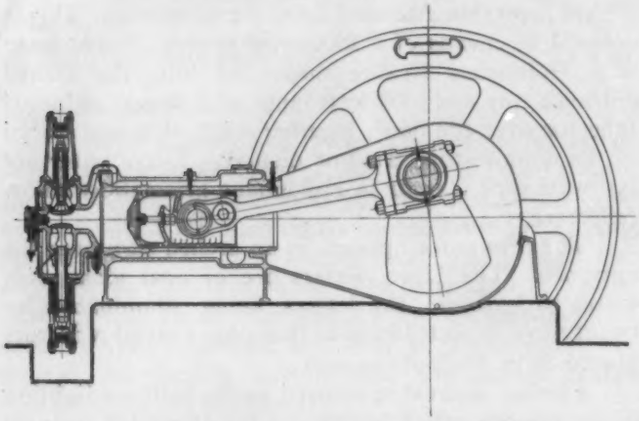


Fig. 18. Section of Allis-Chalmers Engine.

passage which through a nozzle is at all times in open communication with the cylinder. The compressed injection air is closed off from the passage by the injection valve. When this valve is lifted from its seat the stream of air scours over the surface of the accumulated fuel and atomizes it with an action similar to that of a file upon a metal surface. The final atomizing and spreading is performed in the passage through the nozzle as in the case of the Diesel atomizer. The multi-stage air compressor is mounted on the side of the

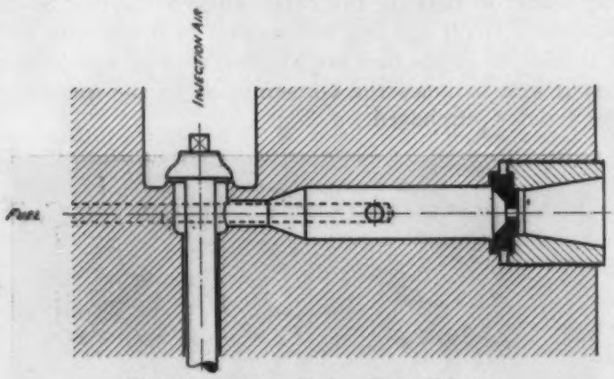


Fig. 19. Lietzenmayer Fuel Nozzle.

frame and actuated from the crank shaft. Air is delivered directly to the fuel nozzle without the use of the usual storage tank. The regulation is performed by varying the effective stroke of the fuel pump plunger under governor control. A gravity oiling system with filtering arrangement and pump is used for all important bearings. The lubrication of the cylinders, and in special cases that of the exhaust valve stems is performed by a forced feed oil pump. The size of the 115 h.p. cylinder operating at 200 r.p.m is 18 in. in diameter, 27 in. stroke. The weight of a 230 h.p. engine of two cylinders of the above size is 160,000 lb., including a 17,000 lb. fly wheel.

The Snow oil engine built by the Snow Steam Pump Works of Buffalo, N. Y., (Fig. 20) is a four-stroke-cycle engine, although this company manufactures engines both of the two-stroke-cycle and four-stroke-cycle. These engines are provided with crossheads. An air compressor is mounted on a pad on the side of frame and is driven by a drag crank on the end of the shaft. The cylinder head, particularly in the two-cycle type, is, of course, free from valves and naturally simple in its construction. The lubrication

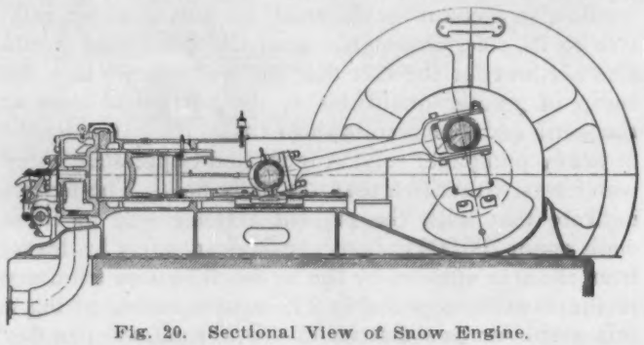


Fig. 20. Sectional View of Snow Engine.

of the cylinder is effected by a Richardson positive force feed pump. These engines employ a modified type of open nozzle and the regulation is accomplished by varying the stroke of the fuel pump plunger by means of a sliding wedge operated by the governor. The piston head in many of the engines manufactured by this company is removable, being bolted on to the piston proper. In this way the portion of the piston which is subject to the greatest heat is easily removable and renewable.

The Dow Willans Diesel type oil engine is built by the Dow Pump and Diesel Engine Company, Ala-

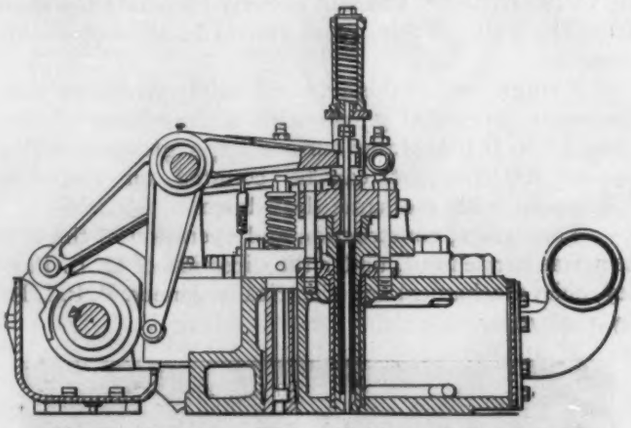


Fig. 21. Section of Willans-Robinson Cylinder Head.

meda, California, under the license of Willans-Robinson of Rugby, England. It naturally follows very closely the design of the engine built in England, which is of the "A" frame type with centrifugal oilers on the crank pins and mechanical lubrication of the pistons pin, the lubrication of the cylinders also being under control of a mechanically operated lubricating pump. The main bearings are ring oiled. This engine is built in 50 h.p. per cylinder, any number of units being combined to make engines of from 150 to 450 h.p. The cam shaft is open type, the valves in the head of the engine being contained in cages shown in section of Fig. 21.) The compressed air for both starting and

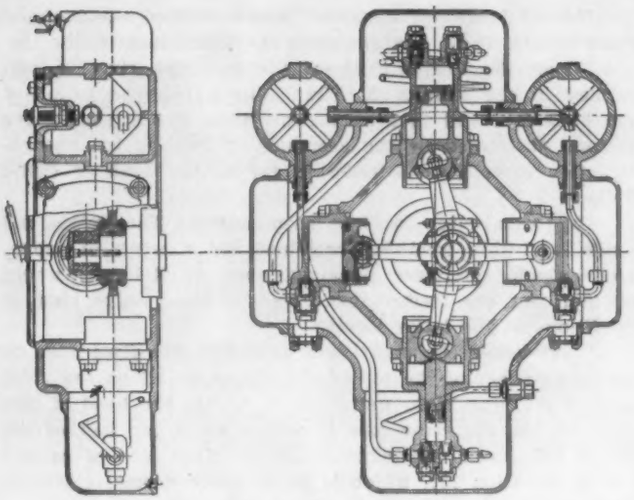


Fig. 22. Willans Compressor.

atomizing is delivered by a Reavell air compressor directly coupled in the end of the crank shaft. This air compressor is of a type built in England and has the four cylinders set two vertically and two horizontally opposite each other. It is of the three-stage type with two cylinders for the first stage. A cut of this compressor is shown in Fig. 22.

The Harris valveless engine, built by the Southwalk Foundry & Machinery Company of Philadelphia, Pa., under the Harris patents, is of the vertical two-stroke-cycle type. Stepped pistons perform the double function of scavenging pumps and low pressure stages of the air compressor, the intermediate and high pressure stages of which are arranged in line with the working cylinders.

The Nordberg Manufacturing Company of Milwaukee, Wis., are to manufacture a Diesel engine under license from Carels Brothers of Belgium. There are at present installed in New Mexico two engines manufactured in Belgium. These are of 1250 b.h.p. in five cylinders and are direct connected to electric generators. These are the largest Diesel engines at present in operation in this country and the report of the purchaser is entirely satisfactory. The Nordberg Company is at present manufacturing a duplicate of the two engines installed under the Carels' license.

Air Compressor.

A typical type of air compressor, see Fig. 22, is of the three-stage type, pyramid piston, capable of compressing to 1200 lb. per sq. in. This compressor is often integral with the engine and driven directly from the main shaft. To avoid lubricating difficulties and the danger of explosion of lubricating oil gases as well as to reduce the dimensions and power consumed in the compressor, it is thoroughly water cooled, being provided with ample inter- and after-coolers. The compressor is provided with automatic valves of very limited lift, closed by springs, the valves being set in cages which can be readily removed for regrinding, and the compressor delivers absolutely cold air at 1000 lb. pressure.

Another type of compressor is a two-stage directly coupled to the engine, the compressor, of course, being thoroughly water-cooled and will deliver air at from 1000 to 1200 lb. per sq. in. All the Diesel engines made in America at the present time supply some type of directly driven compressor. Some manufacturers are directly connecting a separate air compressor by means of a coupling.

The bearings in the vertical Diesel engines are rigid, with ample surface provided for sufficient lubrication so that the wear on them is negligible. The advantage of this rigid construction is obvious in the case of multi-cylinder engines in which there are a number of bearings in line; it is difficult to adjust such bearings without removing the shaft. The lower shells of the rigid bearings are made in a complete circle so that they can be turned out in case of accident by taking off the cap and turning the engine over, bringing the shell on top of the shaft and this can be accomplished without lifting the shaft. The bearing could be then rebabbitted, the bearings scraped in with the mandrel made the size of the shaft and replaced the same way it was turned out. It is necessary in this type of bearing to scrape the cast iron in which the bearing shell rests to a perfect fit to the shell, which requires great care and patience.

The shaft in four-stroke-cycle engines are practically alike; the cranks are set at 180 degrees, the two centers against the two ends; the firing of the cylinders is usually No. 1, 2, 4, 3, No. 1 being toward the fly wheel. The shafts are usually an American product, although some companies were depending on shafts shipped from abroad. The extension shaft of some engines is provided with one outboard bearing, the coupling being inside the crank case. Other engines are provided with two outer bearings, one each side of the generator with a coupling between the inside bearing and engine. The former, with the one outboard bearing, however, has a bearing of extra dimension inside the engine to support the additional weight of the extension shaft, fly wheel and generator, in the case of direct connected electrical equipment. With this arrangement there is less floor room occupied but the two outer bearings prevent a strain on the rigid coupling between the extension shaft and the crank shaft. The fly wheel on the Busch-Sulzer engine is split on the arms, which gives additional strength against bursting over a fly wheel split between the arms, which is, however, the usual practice and the one followed by many manufacturers with good success. The weight of the fly wheel is varied to suit the service performed by the engine, the heaviest fly wheel being provided with engines driving alternating current generators. It is often the case where an engine is belted to design a flywheel that will also be a band wheel and in this way the space occupied is greatly reduced and the expense also lessened.

All Diesel engines are provided with a thorough water cooling system, taking care of the parts of engine which need cooling, such as the cylinders, heads, exhaust valve stems, air compressor and in some cases the exhaust piping. Salt water can be readily used for this purpose; the average cooling water consumption is approximately four to six gallons per horsepower hour.

[To be continued.]

REPORT ON THE COLUMBIA RIVER POWER PROJECT.

BY L. F. HARZA.

Appendix E—Available Power.

Present physical conditions to be met at the damsite. By reference to Fig. 10 (See p. 447, Journal of Electricity, Dec. 11, 1915), it will be seen that the channel at the proposed damsite has a width of about 150 ft. and a depth at low water of about 100 ft. The channel widens and deepens as it progresses until it reaches the large pool about 250 ft. downstream from the neck where the average depth at low water is about 140 ft.

The usual rise at the damsite during the June flood is about 70 ft., and the maximum rise (1894) about 93 ft. Although the annual rise is great, a study of the hydrographs (Figs. 14, 15, 16 and 17, pp. 463-464, Journal of Electricity, Dec. 18, 1915), will show that the river is remarkably free from sudden out-of-season floods so common in most rivers. This uniformity of flow is due to the immense size of the drainage area such that changes in meteorological conditions seldom affect the entire area at the same time, and to the widely diversified climatic conditions obtaining on the watersheds of the individual tributaries, because of which even important individual irregularities become averaged into a smooth curve in the main river. It is believed that the working season can be closely predicted and work planned with reasonable assurances to conform to the regimen of the stream. It will be noted that the low water season extends from about the first of September to the first of April, or about seven months in all, including the winter season, and that this duration is very regular.

The ice phenomena at the damsite are quite variable. Often no ice forms on the river at this place. Occasionally a few days of severe weather cause ice to form here and above, usually lasting but a few days and then going out with a slightly rising stage. In appendix B is given a list of such ice notes as are available in the records of the U. S. Weather Bureau. The many contracted channels such as those at Hellgate, (between Miller's Island and the Washington shore, see Fig. 1), Ten Mile Rapids, Five Mile Rapids and other places are said at times, although only at rare intervals, to cause immense ice jams. In 1909 such a jam existed at Hellgate, at Ten Mile Rapids and also at the damsite, and backed the water up at each place until a considerable head was created. It it said that at the damsite under consideration it so blocked the channel as to cause the water to overflow the rock bench to the right, to accomplish which a rise of 40 to 50 ft. would have been required.

This phenomenon at Ten Mile Rapids and Celilo has been described by W. G. Carroll, U. S. Assistant Engineer, as follows:

* * "The writer resided at Celilo during the winters of 1907-1908 and 1908-9, being in local charge of the construction of The Dalles-Celilo Canal.

"In this period no unusual ice conditions prevailed except during the latter named winter, when more than ordinarily low temperature occurred, extending over a considerable time.

"Ice 12 inches in thickness was harvested above Celilo Falls by Mr. Taffe, and stored in the icehouse at Celilo.

"Upon the breaking up of the icebound river, a jam formed in the vicinity of The Dalles" (believed to be at the damsite) "and in a very short time, the stream above became obstructed by the accumulated drifting ice, the obstruction extending upstream as far as the head of Celilo Falls.

"No open water could be seen between The Dalles and Celilo, and this condition remained for a week or more; above Celilo the river remained open to Hellgate, where another jam was formed, but I had no close range view of conditions at the latter locality.

"Just below the main falls at Celilo, the river rose to within two feet of the top of the riprapped fill on the river side of the boat basin wall." * * * "At the head of Ten Mile Rapids, the river rose to within about ten feet of the top of the canal embankment on the river side of canal," (or to elevation 130, which is 58 ft. above normal elevation for the flow recorded at that time, 65,000 second feet.)

"I am unable to give you the heights at Five Mile Rapids or Big Eddy, as they were observed from the railway train only, this portion of the canal not being under construction at the time."

At minimum stage the average velocity in the river cross section at the damsite is about 7 ft. per second and during a flood stage it is probably about 20 to 25 ft. per second in the main channel.

Usual type of construction. From the conditions recited above it is evident that no ordinary methods of dam construction are applicable here unless at great hazard. Although the depth of water upstream from the neck is comparatively small, yet the depth downstream is great and any cofferdam and concrete work would need to pass through at least one flood. These facts combined with the great range in elevation and volume to be handled argue against any attempt to unwater the site or even to divert the river by means of cribs through a special channel.

Rockfill dam. A rockfill dam to be built without unwatering the river bed appears at first glance to be the only practicable plan. The conditions to be met and the magnitude of the undertaking are however entirely unprecedented even for that type of dam. While the present velocity at low water (7 to 10 ft.) would probably not be sufficient to move large rocks, and while this velocity would be still further reduced by the construction of a bypass or diversion channel of equal cross-sectional area to that of the river channel, it is to be remembered that the introduction of any structure into the channel will create conditions like those of a submerged weir. The local head and corresponding velocities will progressively increase as the structure rises until the latter reaches a point where it will probably remove even the largest and heaviest rocks from the excavation. Furthermore the material deposited in the fill naturally becomes more unstable as the fill rises in height, and is more readily eroded from the lower side of the mass. It may therefore be accepted as fundamental that no rockfill structure made with loose rock from the excavation in the ordinary gradual manner is practicable, and that special means must be provided to insure the rockfill from removal by the current during the stage of construction when the water is flowing over it, if indeed such overflow is to be permitted at all.

Several methods of overcoming these difficulties and of constructing a rockfill dam at this site have been suggested, each of which follows one of the following basic principles:

(1) The deposition of fill material more rapidly than it can be carried away by the current;

(2) The construction of some form of screen or other obstruction to prevent the current from carrying away the fill material so that the work of filling can proceed as slowly as desired;

(3) The use of fill material of such size, shape or make-up as not to be moved by the current.

There has been designed a diversion channel for all types of dams herein considered, whether loose fill or concrete, with bottom elevation 40 and net width of 350 ft. requiring a velocity of about 10 ft. per second for passing 100,000 second feet, when the elevation of water surface is 70 ft. or essentially equal to that required under natural conditions for the same discharge.

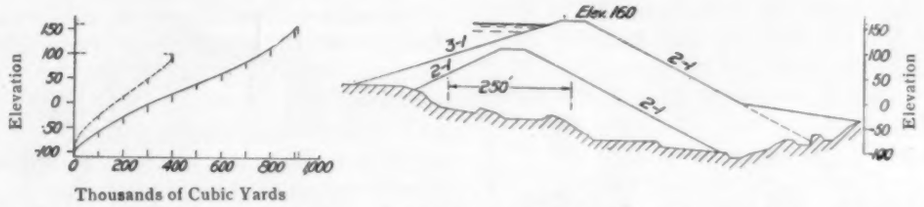


Fig. 29. Outline of Initial Diversion Dam and Final Loose Fill Dam with Curves of Required Material.

In Fig. 29 are shown cross-sections for two dams, one 50 ft. wide, top elevation 100, with slopes of 2 on 1, and the other 50 ft. wide, top elevation 160, with upstream slope of 3 on 1 and downstream slope of 2 on 1. The former is intended as a diversion dam high enough to divert for an 8 months' season of low water. It is the first stage of construction of the latter, which is the completed structure. To conform to the usually accepted practice, the diversion dam (which would consist of very course material to prevent movement by the current) would be built at the location and become a part of the downstream toe of the ultimate dam, instead of in the location indicated by Fig. 29. The local conditions however are not favorable to this plan. The damsite topography (see Fig. 10) shows that the upper neck of the gorge is narrow and shallow, thence widening and simultaneously deeping immediately below to form the great pool. The much more expensive character of the materials constituting the diversion dam as compared to those for the remainder of the fill, and the desire that diversion be accomplished as rapidly as possible, dictate that the diversion dam be built as far upstream in the shallower and narrower channel as possible and yet leave space for a sufficient thickness of finer materials on the upstream face to gain a reasonable degree of water tightness.

At the left of the cross-sections are shown curves of accumulative quantities of all embankment material for both sections. The completed dam would thus require about 920,000 cu. yd. and the diversion dam about 400,000 cu. yd.

To construct from the beginning a dam safe against overflow by an ordinary flood would require completion to at least elevation 130 with 2 on 1 slopes and 50 ft. top width (section not shown in sketch) in eight months, a total of about 550,000 yd., or the placing of about 2300 yd. per day.

Rockfill dam—Plan A. The scheme designated as "A", Fig. 30, is an application of the basic principle No. (1) as previously expressed. It provides for the concentration on the river bank of a large amount of the average material derived from the excavation of the flood channel and bypass, in such a way that it can be precipitated suddenly into the river gorge which it will fill to such elevation as necessary to force the river wholly through the bypass channel prepared in readiness. This would be done at the beginning of a low water season and would permit the dam to be completed during the remainder of that season.

Fig. 30-A indicates an uncoursed rubble retaining wall on each side of the river at the damsite, this wall to be built with rock from the adjacent excavation, using lean cement mortar made from the sand in the sand-bars just above. Behind this wall loose rock would be piled just as it comes from the excavation. At the beginning of a low water period, probably about September 1st, this wall would be destroyed by charging and firing the holes previously drilled, and which are shown by dotted lines in the sketch, by which blast the retaining wall and the rock foundation would be broken along a slope of about 45 degrees. To furnish access to the blast holes for loading, two alternative methods are shown on the two sides of the river. In one, the rear portion of the retaining wall and the loose fill would be built on concrete arches such as shown to the right of the sketch. These arches would furnish access for loading and would be destroyed with the same blast in order that the falling of the superimposed rock might add momentum to the mass.

The other method of loading would be through the tunnel shown in the wall on the left bank. This method would eliminate the concrete arches.

There might also be provided, in the loose rock above the arches, a steel sheet diaphragm on the slope of rupture in order to eliminate any question as to the certain sliding of the material. This diaphragm might also permit the use of a flatter angle than 45 degrees in this portion.

The section of these rock piles shown in the sketch would provide, above the natural rock surface and above the 45 degree line, a combined quantity of 1600 yd. per foot of length, requiring 250 ft. length of pile for the required fill of 400,000 yd. This would concentrate the rock slide in this short distance to min-

imize the tendency of the mass to disintegrate around its surface while displacing the water, and to secure as great a height of crest as possible with a given quantity of rock should it be found that the rock came to rest at a flatter slope than 2 on 1. In reality a longer pile than 250 ft. with correspondingly increased yardage is contemplated, the extra length to be on the downstream side to help fill the deep pool, thereby to reinforce the lower toe and insure as steep a slope as possible when the mass comes to rest. The total yardage precipitated into the river at one time would be about 550,000 yd. with a pile 350 ft. long.

It is proposed that this rock slide shall immediately accomplish the diversion of the river through the by-pass and thus avoid the overtopping of the fill during construction. The dam would next be completed to its ultimate top elevation of 160 and with slopes of 2 on 1 both upstream and downstream during the remainder of the low water season, for which work about eight months during the average year would be available. The material necessary to accomplish this would be about 240,000 yd., and would require the placing of about 1000 yd. per day. Material for this fill would be had in the remnant of the rock piles below the 45 degree line, assumed as the line of fracture.

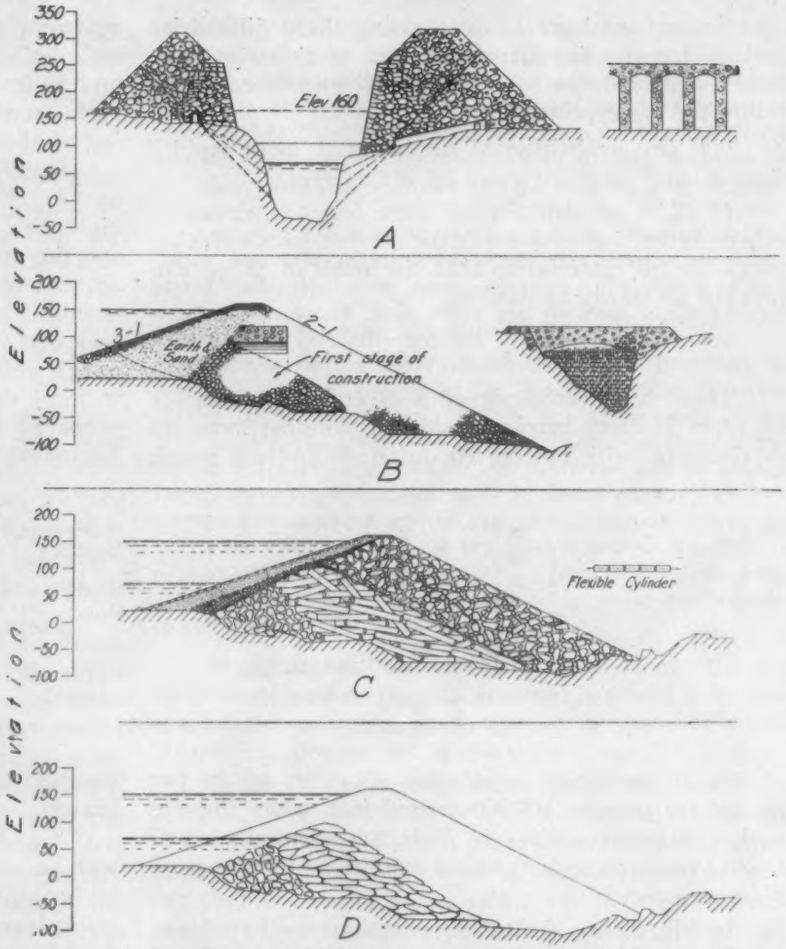


Fig. 30. Suggested Schemes for Loose Fill Dams.

The general proposition of effecting diversion by means of a mass of loose rock thus precipitated into the channel is submitted as being within the range of practicability. It is believed that the release of this rock at the desired moment and not before, by a blast, can practically be assured by the use of proper explosives and if need be by more than one set of detonaters and electric circuits, also that so large a mass of material would reach the bottom of the river channel with such rapidity as to crowd the water in both directions. In this connection it is to be noted that the velocity of the flow in the river channel will probably be not more than 4 or 5 ft. per second at the time of the blast, due to the use of the diversion channel, hence the velocity of flow will not materially affect the disposition of the rock masses in the river channel. Any tendency toward disintegration of the mass of rock as it crowds aside the water, as also the possibility of its assuming flatter slopes than are necessary, can be allowed for by using quantities much in excess of apparent actual requirements.

Before a final and economical design of this dam could be made, much information not now available would need to be obtained by experimental work, especially as to the action of a mass of rock or gravel in settling through and displacing a body of water. Models of the damsite of one or more sizes should be made and the rock slide reproduced with materials of several degrees of fineness, their behavior being carefully observed to deduce the controlling laws.

Rockfill dam—Plan B. The second general scheme, that of retaining the material as it is deposited by some sort of barrier or screen to prevent it from escaping, has many variations, but the method which appears to be most practicable is shown in Fig. 30-B. It consists in building across the channel a very heavy concrete arch; in fabricating upon this arch a network of very heavy chains of necessary mesh which would be paid out as fabricated after first securely anchoring the longitudinal elements of the screen in the wide portion of the river above the neck either individually or by attaching them to a heavy cable well anchored on each side of the river. The fill when commenced would, by the superimposed load, rapidly complete the work of anchoring. The rockfill would be deposited from tracks on this bridge until it emerges from the river and effected a complete diversion through the same diversion channel as anticipated for the rock slide plan previously described. After accomplishing the fundamental purpose of diverting the river the fill would then be completed to ultimate elevation during the next season of low flow. This plan possesses the possible advantage of enabling dam construction to be spread over at least two seasons, thereby permitting construction to be carried on throughout at rates of reasonable practicability. After placing the rockfill the dam would be completed by extending the structure upstream by placing finer material, and finally a comparatively water-tight blanket of earth protected by riprap on the upstream face.

The general principles of this scheme are definite and positive, although its successful design and construction require knowledge not now available by which to determine the stresses in the vertical chains.

Rockfill dam—Plan C. For accomplishing diversion by the third basic principle, that of depositing material of size, shape or makeup such that the current cannot move it, several schemes have been proposed, and two are shown in Fig. 30.

It is well established, both scientifically and experimentally, that the ability of a stream to move an immersed body depends upon the latter's size, specific gravity, resistance to movement and exposure to the current. There is probably some size of material which would not be seriously moved by any velocity to which it would be subjected at the damsite under consideration even during high water, but it is certain that the native basalt would not break out by blasting into sufficiently large pieces to accomplish this purpose.

The schemes proposed therefore anticipate the making of artificial units of fill material designed to combine size and weight with a shape offering minimum exposure and maximum resistance to movement.

One scheme which has been suggested is shown in Fig. 30-C. This consists in casting in a position parallel with the channel long reinforced concrete logs or needles, and in launching them off a rollway such as used by loggers but on a larger scale, or by floating them to place on pontoons. These logs would be so handled as to reach a final lodgment in the river below, in a direction on the main parallel to the channel. As compared with their weight they would offer a minimum surface exposed to the dynamic pressure of the water. Their movement through the water in depositing could be controlled to some extent, if necessary, by a line from upstream which could subsequently be detached. They would be built up to a section essentially that of the smaller dam in Fig. 29 although some loose rock from the excavation could doubtless be dumped at the upstream toe to decrease the number of concrete logs required, as shown in Fig. 30-C, and without fear of erosion by the current if kept at all times well below the crest of the log fill. After diversion, loose rock from the excavation would be dumped, as also other materials grading from coarse to fine, on the upstream slope, as shown in Fig. 30-C, until a satisfactory reduction of leakage and the desired crest elevation is reached.

To the right of this sketch an alternative form of fill unit is shown. This would be cast by means of separators into short lengths with convex ends and held together with a heavy central steel cable running from end to end. The purpose of using this flexible principle would be to insure a more compact fill and prevent breaking of the logs in conforming to the bottoms.

After diversion in this manner the fill would need to be completed in one season, as with the other types, by depositing rock in front and upon the top of the fill, and lastly by finer materials on the front as in all loose fill plans.

Rockfill Dam—Plan D. A possible alternative scheme applying the third basic principle for obtaining units of fill material which would not be carried away by the current is shown in Fig. 30-D. The average rock excavated from the canal and flood channel would be dumped through hoppers into large bags made of a mesh of chains each holding probably from 25 to 50 tons of loose rock. These could be deposited by a traveling crane from an overhead steel bridge or cable-way across the channel and controlled as necessary by a line running upstream, both lines being released when desired. These bags of rock might be made up and stored in some convenient place as in the completed canal, as the excavation progressed so that the actual construction period would be shortened.

The chain bags would be only loosely filled so that they might conform to the bottom. Such a mass could not be moved as easily as could a single piece of equal weight, and they would conform to the bottom better than the concrete logs. While some units of fill material in unstable positions would probably be displaced and carried to the lower toe as a result of high velocities obtaining during the construction period, it is not believed such injury would be sufficient to defeat the scheme, since the stability of the units could be indefinitely increased by increase in size within the limits of practicable handling. Experimental work would be necessary to determine the proper size and makeup of either the elongated concrete cylinder or the chain bag units, to withstand the current during floods.

Plan D, as in the case of Plan C, need not require the exclusive use of artificial fill units. Some loose rock as shown in Fig. 30-D could doubtless be dumped on the upstream toe as the work progressed without danger of erosion by the current. The amount here shown is in both cases a minimum, but the estimates will be based upon the use of special fill units for the entire initial diversion section.

(To be continued.)

THE ATTRIBUTES OF SUCCESS.

Enthusiasm is the thing in a man's makeup which stirs him to make many good New Year's resolutions; determination is the measure of the worth of enthusiasm.

Inspiration leads man to try new things, to seek new ways, to climb; understanding is the attribute which materializes inspiration.

Optimism pulls a man up to a better working plane, keeping him right with himself and with the world; ability crystallizes optimism.

Enterprise starts a man off along new paths; resourcefulness keeps him on the best of those paths and furnishes him with a spur through life.

Initiative lifts man out of his time-worn ruts; fitness keeps him on the crown of the road.

And, above all, responsibility, together with an amalgam of all these attributes, brings success.—Brill Magazine.

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Service Continuity During Storms

The month of January has been a season of unusual precipitation throughout the entire length of the Pacific Coast. High winds have been of frequent occurrence and floods have arisen where the natural channels were insufficient to carry off excess moisture. An occasional flurry of snow has been seen along the coast, and in the mountains the drifts are piled high.

Yet electric light and power lines have suffered comparatively little damage and power consumers but slight interruption to service. This latter fact is remarkable and is largely due to the great foresight exercised by the companies. Extra linemen and material were in readiness to be rushed to any break and repairs were thus quickly made.

Though electric railway service was interrupted by floods in Southern California the damage was quickly repaired. An amusing situation arose at Portland, where the Portland Railway, Light & Power Company kept its tracks free of snow so that the jitneys could run. Thus does the street railroad company not only develop traffic, install the pavement and maintain it in operating condition—for the use of a parasitic industry. Elsewhere, however, comparatively few jitneys were able to operate during the storms and many people gladly availed themselves of the comfort, safety and reliability of the electric car.

Few people realize the preparation that is necessary to anticipate any interruption to power service and still fewer appreciate the hardships endured by the linemen in preserving continuity of service. Think of working thirty-six hours at a time without sleep and with little to eat, climbing a swaying pole in a gale of wind when a false move brings liability of a high voltage shock, wet to the skin, cold, hungry—the lot of the lineman is not an easy one. His uncomplaining acceptance and his tireless efforts in the face of such difficulties entitles him to the respect, consideration and thanks, not only of his company, but also of the public he is aiding to serve.

Aside from temporary inconvenience, however, the electric light and power companies have suffered little damage from this season's storms. The abundant rainfall is a great blessing, as a whole. It gives assurance of good crops, and an ample supply of water for the generation of hydroelectric power during the year to come.

Anticipating Complaints

Complaints are the bugbear of public service corporations. So many complaints are unfounded in fact that it has become the custom among electric power companies, particularly, to install an explainer at the complaint desk, an affable gentleman impervious to insult and quick of wit in devising excuses. This system works admirably for the ninety-nine mistaken complaints, but fails miserably when the one real complaint appears.

Most complaints are due either to alleged overcharges or to service disconnection because of nonpayment of bill. In the former case it is usually sufficient to explain the integrity of meter readings and to suggest possible reasons for excessive consumption

of current. In the latter case an appeal to the spirit of fairness ordinarily suffices to show the justice of such action.

But there are times when meter readers make mistakes and there are circumstances when non-payment should be extenuated. Yet the machine-like procedure of the complaint desk is incapable of discrimination and an injustice may be done which brings the blush of shame to the general manager's cheek, an injustice so manifest as to tend to bring the entire organization into disrepute.

How to obviate such occurrences is a serious problem in central station management. Instruction as regards tact and courtesy is not always effective. It is rather much to expect that every representative of the company should possess the same good judgment as would be displayed by the management.

And yet there is a means whereby many complaints can be eliminated. It involves additional care and greater expense, but the care is compensated by the reduction in the number of complaints and the expense is partly balanced by certain errors against the company which can be rectified.

This method requires that each bill be carefully compared with former bills and if any discrepancy be noted that the cause be investigated before the bill is mailed. The comparison should be made with understanding and judgment. It should find out, for instance, that a revenue of one hundred dollars per horsepower of installed capacity in the case of a five horsepower motor is excessive in a city where fifteen dollars is the prevailing revenue. How much better would the customer feel if the company informed him of this fact and offered some restitution instead of allowing the solicitor of a competing company to discover it.

So it must be recognized that there are complaints and complaints. All cannot be classified under the same category and dismissed as figments of the imagination. Wise, indeed, is that company who substitutes a "satisfaction" desk for the complaint desk.

A Ghost that Will Not Down

It is reported that the head of a great government bureau at Washington has again "discovered" a grave monopolizing tendency which gives evidence of the existence of a gigantic water power trust and the inference is that additional corporation control is to be proposed for the further disintegration of commercial power. It is indeed strange that even among the most enlightened there is a seeming inability to distinguish between business operations which are essentially monopolistic in their most beneficial intent and those in which monopoly is a menace.

To illustrate the danger of this water power monopoly it has been pointed out that private plants invest more than double the sum than do municipal plants per horsepower developed, though on what basis the comparison is made the reports to hand fail to state. Municipal hydroelectric development is so insignificant compared with that undertaken by private enterprise—else why the fear of private monopoly—so recent, too, as to have escaped the high cost of pioneering and to have benefited in this respect by costs borne entirely by private enterprise, that it seems impossible, no matter how good intentioned, that any government official could have really found a fair basis of comparison for his development cost figures.

Now the fear of monopoly is that it will destroy competition by destroying the small producer; that it may withdraw its commodity from the market, and by these and other means cause higher prices to be paid for its product than would be the case if monopoly did not exist.

The product of a water power monopoly could hardly be withheld from the market, seeing that it must be sold as made and that its non-use means entire loss, neither could it destroy its competitors, seeing that commission control has—strange vagary of governmental paternalism—found it essential in the interests of economy to eliminate competition and this same safety valve also regulates the price of the product irrespective of the actual amount of the investment.

So it would seem that there is no "grave danger" but rather a national advantage in water power monopoly and the fear expressed but argues against interference with natural law in the business world.

Finally it was definitely proved during the December, 1914, hearings before the Senate Committee on Public Lands that there is no such thing as a water-power monopoly in the United States. Whatever centralization that has occurred has been to promote economy of operation and has no bearing on an attempt to control the output of what is fast becoming a public necessity. This waterpower trust is another of those errors, which, like ghosts, will appear as long as men believe in them; the demand brings the supply.

What Constitutes Public Use

The United States Supreme Court in its decision upholding the constitutionality of the Alabama water-power condemnation statutes, definitely holds that the states can authorize eminent domain condemnation of power sites and water rights. While this decision applies specifically to state lands, and thus only confirms present practice, there is a possibility that it includes Federal lands. If so, this decision is of far-reaching importance, as it may permit the development of many irrigation and power projects which have been prevented by Federal refusal of rights of way across public land.

In brushing aside the chief objection to this appeal—that the purpose of condemnation is not a public one—Justice Holmes paid a well-deserved tribute to the men who are developing latent waterpowers:

"But to gather the streams from waste and to draw from them energy, labor without brains, and so to save mankind from toil, to supply what next to intelligence is the very foundation of all our achievements. If that purpose is not public, we should be at a loss to say what is."

Many experts believe this decision offers a solution to the controversies that have arisen over oil-land and water power site withdrawals. It is as yet too soon to confirm this hope, as they are based upon brief telegraphic reports of the decision.

PERSONALS

C. B. Aitchison, chairman of the Oregon Public Service Commission, is at Washington, D. C.

H. E. Sherman Jr., Los Angeles representative of H. B. Squires Company, was at San Francisco last week.

F. J .Wallace, of the Wallace & Smith Electric Company of Lodi, California, was a recent visitor at San Francisco.

H. W. Beecher, manager of Chas. C. Moore & Company's Seattle office, was at San Francisco during the past week.

S. C. Bratton, commercial manager for the Portland Gas & Coke Company, is back at his desk after a siege of illness.

W. D. Hayes, proprietor of of the Hayes Electric Shop of Santa Rosa, California, spent the latter part of the week on a business trip to San Francisco.

H. D. Shute, treasurer of the Westinghouse Electric & Manufacturing Company, is expected to arrive at San Francisco about the end of the week.

A. J. Meyers, Pacific Coast manager of the Wagner Electric Company, St. Louis, Mo., is expected to return from a short business trip to Los Angeles about the first of the week.

H. M. Jones has resigned as new business manager of the Lewiston-Clarkston Company to take effect March 1, 1916. He has purchased the Fifth street garage at Lewiston, Idaho.

J. J. Jackson, general attorney of the Westinghouse Electric & Manufacturing Company at Pittsburg, Pa., will arrive on the 28th of this month for a short business trip on the coast.

H. W. Cope, in charge of the Westinghouse Electric & Manufacturing Company's exhibit at the P. P. I. E., has finished his work and expects to leave for the East about the first of the month.

A. F. Mencel, of the engineering department of the General Electric Company, who has been stationed at the exposition for the past year, has recently left for the East in charge of one of their 600 ton electric locomotives.

H. S. Jones, formerly salesman with the Busch-Sulzer Diesel Engine Company at San Francisco, has recently severed his connection with that company and has joined the sales forces of the Robbins-Meyers Company at San Francisco.

G. I. Kinney, who has been for the past year manager of the General Electric exhibit at the P. P. I. E., has recently finished the dissembling of the exhibit and has again taken up his headquarters in the Rialto Building, San Francisco.

A. N. Irwin, assistant to treasurer of the Westinghouse Electric & Manufacturing Company, has just returned from a business trip throughout Texas and Arizona, he having experienced considerable excitement along the Mexican border.

I. W. Simpson, Western district manager of the Federal Sign System (Electric) of San Francisco, has just returned to his home office after an extended trip throughout the Western States in company with **H. I. Markham,** general manager of that company, of Chicago, whom he left at Salt Lake City on his return East.

W. B. Foshay, at one time district Manager of the Washington-Oregon Corporation at Walla Walla, and later manager of the Northwestern Electric Company at Portland, until he took up consulting work at Portland two years ago, is now associated with Page & Hill Co. of Minneapolis, Minn., producers and distributors of cedar poles.

W. D'A. Ryan, illuminating engineer with the General Electric Company, has returned East after submitting to the San Francisco Board of Supervisors a plan for the illumination of Market street with luminous arc lamps from the Exposition.

OBITUARY.

Frank Hastings Varney, engineer of operation and maintenance of the steam-electric department of the Pacific Gas & Electric Company, died at San Francisco, January 21, 1916, after an illness of several months. While his many friends knew of his indisposition the end came as a sad shock to all. Frank Varney was one of the most liked engineers in the West. Starting as an operator in 1893 in the old Station C of what is now the Pacific Gas & Electric Company, he rose by dint of hard work and rare ability to the head of his department, retaining meanwhile the high regard of all with whom he came into contact. He was but 43 years of age at the time of his death and because of his executive ability seemed destined for even greater advancement. Here passeth a man who made this world a better and a happier place for his having lived in it. Funeral services were held January 24th, under the auspices of California Commandery No. 1, Knights Templar. The pallbearers were: John A. Britton, Geo. C. Holberton, P. M. Downing, W. S. Hyde and C. A. Eastwood, representing the Pacific Gas & Electric Company, and C. R. Weymouth, E. O. Shreve and Fred Gay. Mr. Varney is survived by a widow and two young children.

MEETING NOTICES.

Portland Sections A. I. E. E. and N. E. L. A.

At noon, Thursday, January 20th, the regular bi-monthly meeting was held in the dining room of the Portland Commercial Club, with 40 members in attendance. Mr. Glenn Miller of the University of Oregon school of commerce, made an address upon "Business Economics." He pointed out in a brief way how the war in Europe had affected credit in this country, also the money market. He also pointed out what would likely be the conditions after the war was over. J. E. Davidson presided as chairman. At the next regular meeting of the Portland Sections of the A. I. E. E. and the N. E. L. A. to be held February 8th at 8 p. m. in the Electric Building, Portland, Oregon, the speakers of the evening will be Edward Cookingham, cashier of the Ladd & Tilton bank, on the subject of "Financial Lines," and Ben Day, attorney for the Southern Pacific Company, who will speak on "Elementary Principles of Law."

San Francisco Electrical Development and Jovian League.

"Reprisal," or how cutting cut off Leggett for forgetting a birthday, enlivened the league meeting on January 19th. This was an effusion in approved K. C. B. style which preceded the usual introduction of guests and of R. M. Alvord as chairman of the day. Mr. Alvord presented members of the Y. M. C. A., who gave cornet, piano and vocal soloes which were greatly enjoyed and then introduced Lyman Pierce, secretary of the Y. M. C. A. as the speaker. Mr. Pierce emphasized the importance of the human element in building a city and showed how the Y. M. C. A. was developing the requisite qualities of virile manhood. He cited several instances where big electric corporations, lumber companies and railroads had delegated much of their welfare work to this organization, paying all expenses, not as a matter of sentiment, but as a matter of sound business. He also showed where the association acted as an ounce of prevention instead of the pound of cure administered by expensive state prisons. He concluded his talk by eulogizing the achievements of San Francisco men in rebuilding the city and carrying through a great exposition and asked their help in assisting the Y. M. C. A to maintain this high standard of manhood. The meeting was closed by a rising vote of thanks to the speaker and to Mr. Alvord.

Los Angeles Jovian League.

The regular weekly meeting was held Wednesday, January 19th, at Christopher's, with a large and enthusiastic attendance. Henry F. Holland presided, with J. Wesley

Finch acting as chairman of the day, who was responsible for a program which was voted by all present to be a "corking" good one. J. E. McDonald, secretary of the Los Angeles Joint Pole Committee, read a most interesting and instructive paper, "A Brief Outlook on the Blue Sky Law, Prospective and Prospective." He outlined the difficulty of maintaining the distributing systems, in eliminating the unnecessary duplication of poles, of which there are almost 100,000 in Los Angeles today. As an expert, the facts and figures presented concerning pole line construction, maintenance, etc., would indicate that the duplication of poles would be a serious problem, in the event the municipality parallels a portion of the system of the Southern California Edison Company, which it is contemplating doing. It is his opinion that the additional installation of the 70,000 poles necessary, would mean a cost of $5 annually to every taxpayer. "Duplication has never yet been known to offer a reduction in cost to serve, and a duplication of 45 per cent of the power system would cause a severance damage to the central station, and every unnecessary pole erected in Los Angeles must ultimately be paid for through the customers' meters or by direct taxation."

K. E. Van Kuren commented upon the educational value of the paper, stating that the information it contained should be of absorbing interest to all present, in view of the power situation in Los Angeles at present, and upon his motion the paper was ordered published and distributed.

H. L. Carnahan, state commissioner of corporations, was to deliver an address on the Blue Sky Law, but was detained by storms en route from San Francisco. His visit was looked forward to with pleasant anticipation and his unavoidable absence was regretted by all. He was ably represented, however, by H. W. Bowman, Deputy District Commissioner, who in a simple, forceful manner, gave a resume of the Blue Sky Law, which has been in effect in this State since December, 1914, assuring the league that it is the intention of the commission to be of all possible assistance to corporations in helping to promote and support legitimate business. He stated that $30,000,000 values in stock, patents and mining claims were escrowed through the commission, and permits issued on $200,000,000 worth of securities last year. Several splendid musical numbers completed the program.

California Association of Electrical Contractors and Dealers.

The quarterly meeting of the association was held at the Palace Hotel, San Francisco, January 21st, President C. V. Schneider presiding. Annual financial reports were received and the final reports of W. S. Hanbridge, retiring secretary, were adopted. The resignation of L. R. Boynton, because of his removal to Arizona, was accepted and he was elected to honorary membership in both the state and the San Francisco association. Reports were received from the committees on the price book, sample room, telephone specifications and insurance. The by-laws were also revised so as to specify the qualifications for membership.

In the evening a dinner was held at the Palace Hotel, jobbers and central station representatives being invited. This was a most pleasant affair as about ninety were in attendance. M. A. De Lew presided as toastmaster.

In the course of the evening, Mr. Jas. F. Brennan, assistant district attorney, entertained the gathering with stories and recitations.

R. S. Holabird explained the revision in the prices of all heating appliances due to the Nichrome wire patent situation. He also gave details of the method of sale.

J. A. Cleary, electrical inspector with the Board of Fire Underwriters, told of the changes in the new code and explained what it meant to the contractor. He also answered a number of questions regarding the code, including the subject of refillable fuses, making the statement that these finally had not been approved because a deposit of carbon occurred after continued blowing of the fuse.

Upon behalf of the association, F. J. Somers presented the retiring secretary, W. S. Hanbridge, with a handsome silver service. In accepting this Mr. Hanbridge expressed the pleasure in his past work and pledged himself to continue in his efforts to advance the standing of the association.

D. B. Farquharson then gave an interesting talk as to the reasons for poor business conditions. He stated the building industry of San Francisco represented 45 per cent of the business done in the city and urged that greater recognition be sought by these interests. He showed that whereas the general contractor, architect and the owner is usually blamed for poor business, as a matter of fact the fault lay with the specialty contractor, who is willing to cut prices below a profitable point in order to get the business.

Upon motion of W. S. Hanbridge, the association voted to endorse the proposed scheme of illumination of Market street and instructed the secretary to advise the board of supervisors of their action.

The meeting was brought to a close by an interesting stereopticon lecture on the methods of laying a power cable across the Golden Gate by S. J. Lisberger, engineer of distribution for the Pacific Gas & Electric Company.

The following were in attendance:

H. A. Porter, Porter Electric Co.
J. A. Cleary, Board of Fire Underwriters of the Pacific.
C. F. Butte, Butte Engineering & Electric Co.
S. J. Lisberger, Pacific Gas & Electric Co.
Frank J. Somers, Century Electric Co.
C. V. Schneider, Electric Supply Co.
W. S. Hanbridge, Hanbridge Electric Co.
J. G. Creighton, Pacific Coast Spec. Co.
J. W. Wood, Pacific Coast Spec. Co.
Hal Lauritzen, Pacific States Electric Co.
M. Fortini, Standard Electric Const. Co.
Nathan A. Bowers, Electrical World.
R. T. Kahn, Electric Railway & Manufacturers' Supply Co.
F. C. Porter, The Electric Shop, Oakland.
J. Gensler, Electrical Const. Co., Oakland.
D. E. Harns, Pacific States Electric Co.
R. V. Oyler, Capitol Electric Co.
Hugh Kimball, Kimball Electric Co.
R. E. Fisher, Pacific Gas & Electric Co.
C. J. Newbery, F. E. Newbery Electric Co.
F. H. Mills, Electric Appliance Co.
W. T. Kohlwey, Kohlwey Light Co.
Geo. G. Drew, Pacific States Electric Co.
S. G. Jackson, Berkeley Electric Const. Co.
G. H. Andrews, Contractor, Oakland.
S. Bushman, Oakland.
F. J. Wallace, Wallace & Smith Elec. Co., Lodi, Cal.
Geo. D. L. Smith, Electric Motor & Machine Co.
A. A. Elick, Pacific States Electric Co.
Geo. H. Curtiss, Pacific States Electric Co.
C. L. Gilson, Gilson Electric Supply Co.
W. S. Berry, Western Electric Co.
R. D. Holabird, Holabird-Reynolds Co.
F. J. Cram, Electric Appliance Co.
T. O. Dowdell, Solano Supply & Const. Co.
Arthur J. Maloon, Oakland, Cal.
H. I. England, Gilson Electric Supply Co.
S. L. Hancock, Rex Electric Co.
A. H. Nylen, Gilson Electric Supply Co.
C. S. Renwick, Pioneer Electric Co.
R. F. McDonald, Holabird-Reynolds Co.
Robt. King, King's Electric Co.
Wm. Beamin, Gas & Electric Appliance Co.
V. A. Kuehn, Gas & Electric Appliance Co.
A. H. Halloran, Journal of Electricity, Power and Gas.
D. J. Collins, Pacific Electric Mfg. Co., Richmond.
B. J. Ballantigan, Pacific Electric Mfg. Co., Richmond.
E. A. Crowson, Western Electric Co., Oakland.
V. B. Gilpin, Piedmont Electric Co., Oakland.
M. F. Nagle, Bay Electric Co., Oakland.
E. W. Lauer, Rex Electric Co., San Francisco.
H. H. Hoxie, Electric Railway & Manufacturers' Supply Co.
T. J. Bennett, Rex Electric Co., San Francisco.
M. E. Ryan, Redwood City.
Thos. H. Nernes, Pacific States Electric Co., San Francisco.
J. A. Foster, San Mateo, Cal.
W. C. Martinez, Western Electric Co.
B. C. White, Contractor, Berkeley.
N. P. Ellis, Oakland Electrical Co.
Geo. A. Sittman, General Electrical Const. Co.
M. E. Hickox, Pacific States Electric Co.
J. A. Richmond, Decker Electrical Const. Co.
M. L. Scobey, Home Electrical, S. F.
H. C. Herning, Electric Railway & Manufacturers' Supply Co.
C. L. Chamblin, California Electric Const. Co.
T. H. McDonnell, California Electric Const. Co.
A. Younghoim, Electric Railway & Manufacturers' Supply Co.
W. L. Neelands, Western Electric Co.
B. Badrian, Pacific States Electric Co.
H. E. Coyle, South San Francisco.
M. A. DeLew, San Francisco.
Wm. E. Hayes, Santa Rosa.

SOUTHERN CALIFORNIA EDISON CONDEMNATION HEARING.

At the conclusion of the testimony of S. M. Kennedy before the Railroad Commission of California in its hearing on the condemnation of the company's distribution system in Los Angeles, (as reported in this journal, Jan. 15, 1916), Dr. Geo. L. Hoxie was recalled to explain projected curves on the company's historical chart.

Mr. Ballard then again took the stand and testified that in order to secure the recovery of its peak or maximum demand upon its generating system, to replace the maximum demand in Los Angeles business, the company would be required to spend a total of $4,438,380.17 in the next eight years for extensions and additions to its distributing properties outside of Los Angeles and some small additions to its generation and transmission system to secure the maximum possible efficiency.

The expenditures by years were estimated as follows:

Year ending June 30, 1916	$ 458,800.00
" " " " 1917	468,800.00
" " " " 1918	478,800.00
" " " " 1919	498,800.00
" " " " 1920	508,800.00
" " " " 1921	601,374.40
" " " " 1922	673,827.35
" " " " 1923	749,178.42
Total	$4,438,380.17

After the expenditure of this large sum of money, Mr. Ballard estimated that the company would have recovered its maximum demand upon its generating stations, but owing to decreased efficiency caused by the separation of the Los Angeles business from the system, the kilowatt hour sales would be 30,000,000 a year less than before severance, resulting in a decrease of $950,000 a year in gross earnings.

Mr. Arthur R. Kelley, formerly electrical engineer with the railroad commissions of the states of Washington and California, testified that he had been at work for the past sixteen months making an inventory and appraisal and a general study of the property of the company and a determination of all items of value, both physical and commercial, as well as the large severance damages.

Mr. Kelley at this point in the case gave the result of his study of the condition of the entire properties of the company with respect to accrued depreciation. He testified that all of the properties of the company were maintained in a very high state of efficiency, the depreciated value of the general properties, including power plants and transmission lines, being 85 per cent of their cost and of the distributing properties of the company, both inside and outside of Los Angeles, 80 per cent of their cost.

Expert Gillette on Depreciation.

Mr. Halbert P. Gillette of New York, formerly chief engineer of the railroad commission of the state of Washington, testified to an experience of twenty-three years of engineering work involving inventories and appraisals of public utility properties amounting to six hundred and seventy-five millions of dollars.

He was employed by the company six months ago especially to study its properties with a view of determining exactly the amounts which should be fairly allowed annually, in addition to regular operating expenses, for depreciation in order to maintain the properties in a high state of efficiency.

Mr. Gillette testified on the subject of depreciation, stating the allowance which should be made to the company for this item in connection with the property remaining to it outside of Los Angeles, starting with an allowance of $534,279 for the year 1916, with increasing allowances each year thereafter, to a total of $673,878 in the year 1923, during which year the company estimates it will have the same peak demand upon its generating system in business outside of Los Angeles as it had during the year 1915 when its business included both Los Angeles and outside territory.

Mr. Gillette defined his method of arriving at the cost of depreciation as the cost, or historical method, of arriving at depreciation, current repairs and maintenance, rather than a method based upon the assumption of different lives for different classes of equipment. It is a complete method of determining what has happened in the past nineteen years' history of the company.

Dr. Hoxie followed and under examination of Mr. Dunne testified that he was familiar with the method of expressing the percentage for the depreciation annuity reserve as computed by Mr. Gillette and considered it distinctly preferable to any method yet suggested for that purpose.

President Edgar on Severance.

Charles L. Edgar, president of the Edison Electric Illuminating Company of Boston, gave a deposition on severance damage which was presented at the hearing. In reviewing the growth and scope of his company's operations, Mr. Edgar stated the capitalization had increased from $100,000 in 1887 to approximately $45,000,000 at the present time. It has the unique distinction of carrying no bonded debt and its excellent financial condition is reflected in the high price of its capital stock, which price is regulated by public authority. The gross earnings of the company are approximately $7,500,000, about two-thirds of which is derived from the city of Boston, the balance from its operations in suburban territory.

The company supplies electric energy to 40 municipalities and in the city of Boston its operations cover the entire city with practically no competition.

In outlining his method of determining the amount of damage Southern California Edison Company would suffer by the severance of its Los Angeles property and business from the balance of the system, Mr. Edgar stated that he had applied this same method some years ago in his own company.

In speaking of diversity of demand and its direct connection with economic and efficient operation of electric companies, Mr. Edgar stated the Southern California Edison Company had a remarkable condition in this respect, due to the lighting business in Los Angeles, whose peak occurs in the winter, and the irrigation business in the outside territory, whose peak comes in the summer. This extraordinary condition, which enables the company to supply a larger demand with less installation, would be entirely destroyed by severance, the character of the business permanently changed, and the value of the business decreased accordingly.

Mr. Ballard analyzed the deposition of Mr. Edgar. In reviewing the document, Mr. Ballard applied figures relative to costs, earnings, etc., for the year ending June 30, 1915, to the method outlined by Mr. Edgar determining severance damage and showed that according to Mr. Edgar's method of calculation, the severance damage would be $11,096,283.88. This method involves the analysis of the cost of the property to provide for the elimination of the Los Angeles distributing system and a complete analysis of all items of earnings, and operating expenses to show what reductions would be made by the loss of the company's Los Angeles business. With this determined, projections of earnings, operating expenses, additional capital requirements and load conditions on generating plants were made for a period of eight years in the future to arrive at the time when the addition of business outside of Los Angeles would have resulted in a maximum, or peak, load on generating stations equal to the peak load of the combined system at the present time.

It was shown that the company would be required to spend in the districts outside of Los Angeles $4,438,380.17 to secure new business; its depreciation account would increase from $471,000 per annum to $614,000 per annum, and its operating expenses from $1,222,000 per annum to $1,607,000 per annum. During the same period its gross revenue would increase from $2,318,000 per annum to $3,477,000 per annum in this outside territory.

While the combined system before severance was earning net 7.9 per cent, its net earning in 1923 would be $524,000 less than 8 per cent per annum, which is considered by the railroad commission to be a minimum fair return on the cost of its property used to supply the service.

The annual deficits below 8% were then computed, showing that in 1916 this deficit would be $815,000 reducing gradually each year until in 1923 the deficit would be $524,000. The damage caused by these deficits, figured as of the present time, allowing compound interest on the funds at 4 per cent per annum until needed for payment of bond interest and operating expenses, would be $4,588,035.25 The permanent damage, calculated as of the year 1923, and allowing compound interest in the meantime, was arrived at by capitalization of the 1923 deficit and amounted to $6,508,248.63. The sum of these two items constitutes the severance damage, $11,096,283.88.

Mr. Ballard also explained in great detail the importance of a fair interest rate on depreciation annuities—which the company in all its calculations in this case had assumed to be 4 per cent per annum.

Mr. Insull Says Economic Crime.

Mr. Samuel Insull, the foremost operator of public utility properties in the United States, was the next deponent on the question of severance damage. He firmly and ardently declared that in the electric industry, economies in operation are to be effected chiefly by concentration of production and a unified system of distribution.

Mr. Insull brought out emphatically that the economic trend in the distribution of electric energy is toward very large distribution systems with a few large power stations; the reason being that experience has proven that is the only way to get the lowest possible cost and consequently the lowest possible selling price to the consumer.

As an illustration of this, he cited the case of a company in his territory, serving a small community, which by consolidation of plants and distribution systems more than doubled the number of consumers in a period of two years. At the same time, the number of towns served doubled; the kilowatt hours sold trebled; the gross income doubled; the income per kilowatt hour decreased nearly 20 per cent; and the load factor doubled.

Where a concentration of properties into a unified, connected system has resulted in advantageous diversity condition and advantageous load factor, such as pertains to Southern California Edison Company, Mr. Insull stated that a separation of any part of such system from the whole, with the consequent disruption of these conditions and enormous destruction of values, would result only in waste, to be borne by the community, and is an economic crime.

Mr. Insull, in his method of calculating severance damage, divided the damage into four different items; the investment damage due to loss of diversity; the operating damage due to loss of diversity; the fixed charges on idle investment; and the damage due to the difference between 8 per cent net return on investment obtainable without severance and continuance of present basis on which foregoing calculations are based.

Following the introduction of Mr. Insull's deposition, Mr. Ballard submitted a computation based upon Mr. Insull's method showing total severance damage in the sum of $10,945,039.57.

Mr. Ballard, the last witness for the company, testified briefly on each item of the total claim for just compensation.

In closing his testimony, Mr. Ballard submitted two methods of determining just compensation as viewed strictly from the financial standpoint.

The "Banker's Method" embodied two calculations; one, assuming the amount paid as just compensation to be used for the retirement of all bonds outstanding and the remainder reinvested in new property; the other assuming the retirement of underlying bonds secured by mortgages which specifically include the Los Angeles property and the balance deposited in Special Trust Fund for future construction expenditures.

Just compensation by the "Banker's Method" amounts to $22,551,431.60.

The "Method to Preserve Equities of Bondholders and Stockholders," as its title implies, covers the question from the standpoint of the bondholder and stockholder. It stipulated that just compensation has been made when, and only when, all persons who have rights against the properties are left in a position substantially as favorable as that occupied by them before their property was taken.

By this method the just compensation would be $23,630,603.30.

To both of the above methods should be added such an amount as is determined will be the cost of reconstructing transmission lines in order to remove all lines from Los Angeles city.

APPLICATIONS TO CALIFORNIA WATER COMMISSION.

Charles E. Manley of Stauffer, Ventura County, has applied to the commission for permission to appropriate 3 second feet of water from Bitter Creek, a tributary of Lockwood Creek, at a point in the SE ¼, S ¼, SE ¼, Sec. 27, Tp. 8 N., R. 21 W., S. B. M. Applicant proposes to irrigate 430 acres, conveying the water to his land by a ditch approximately a mile in length. J. S. Manley and Geo. Wesseman of Fowler are witnesses to the application.

The Death Valley Consolidated Mining Company of Los Angeles has applied to the commission for permission to appropriate 10 miner's inches of water from Willow Creek, which sinks into Death Valley.

Edward E. Elder and F. L. Young of Lone Pine and Keeler, have asked permission of the commission to divert for agricultural purposes, 2½ second feet of the waters of Panamint Canyon, from a point in Sec. 6, Tp. 21 S., R. 45 E., M. D. M., Inyo county. A pipe line three miles long, at an estimated cost of $2500 is proposed to conduct the water to irrigate 320 acres of lands of applicants.

Jos. R. Ghiselin of Los Angeles has applied to the commission for permission to appropriate 375 second feet of water from Piru Creek, tributary to the Santa Clara River in Vetura county for hydraulic mining. The diversion is asked from the SE¼, SE¼ of Sec. 14, Tp. 7 N., R. 19 W., S. B. M. The application sets forth that the water is to be diverted by means of a concrete and timber dam, and there is an intended storage reservoir with a capacity of 9100 acre feet, with a storage dam also constructed of concrete and timber. The water, according to the application, is to be conveyed by a pipe line and ditch, twenty miles long and terminating in Temescal Rancho. The water is to be used to mine out auriferous gravel deposits. The estimated cost of the works is given at $250,000. Lewis Cruckshank and John F. Clark, both of 1326 Washington street, Los Angeles, are given as witnesses to the application.

C. E. Williams of Yuba City has applied to the commission for permission to appropriate 20 second feet of the waters of Snake River Drainage Ditch, tributary to Sutter Tule Basin, in Sutter county. The proposed point of diversion is in the NE ¼, SW ¼, Sec. 3, Tp. 13 N., R. 3 E., M. D. M. The water is to be used for irrigation purposes and there are a removable timber dam to allow of the escape of the flood waters, and five-mile ditch in the proposed works.

The California Chief Development Company of Forest Hill, Placer County, has applied to the commission for permission to appropriate 80 miner's inches of Owl Creek tributary to the North Fork of the American River, for mining purposes. W. Fitch is president of the company.

Oscar and Etta Glanville of Majave, Kern county, have applied to the commission for permission to appropriate for agricultural purposes, four second feet of the water of Cotton-

wood Creek, in Sec. 29, Tp. 30 S., R. 36 E., M. D. M. There is proposed a diversion dam 40 ft. high, 150 ft. on top and 100 on bottom, built of concrete, masonry and broken rock, at a cost of $17,500. A main ditch 3½ miles long is intended to carry the water to 239 acres to be watered.

The Lindsay-Strathmore Irrigation District, with headquarters at Lindsay, Tulare county, has applied to the commission for permission to divert water from two streams for the purpose of irrigating some 15,500 acres in that district. The first diversion is asked from the South Fork of the Kaweah River, being for 15,000 acre feet. A diversion dam and a storage reservoir capable of holding 22,000 acre feet of water, with a ditch and tunnel 6 miles long are included in the works, which it is estimated will cost approximately $450,000. The second source of diversion is the North Fork of Tule River, where it is asked that an appropriation of 12,000 acre feet be granted. There is also a ditch and tunnel five miles long connected with this diversion and a storage reservoir. The cost of the works of this diversion is estimated at $150,000. The applicant sets forth that it will take two years to complete the works and that it will be three years from that time before the whole district will be brought under the ditches. The commission has allowed the district sufficient time in which to file maps and other more complete data.

BOOKS REVIEWED.

"Inventions and Patents," by Philip E. Edelman; 288 pp., 5x8 in. Published by D. Van Nostrand, New York, and for sale by Technical Book Shop, San Francisco. Price, $1.50.

With the avowed purpose of clearing some of the misunderstanding regarding patent matters, the author discusses the patent system and the U. S. Patent Office, giving the steps necessary to secure patent and ideas as to protecting and disposing of patent rights. The style is readable and the treatment thorough. The book is filled with information which should be known by anyone wishing to get a patent or invest in one.

"Principles and Practice of Cost Accounting," by Frederick H. Baugh; 180 pp., 6x9 in. Published by the author, Box 682, Baltimore, Md., and for sale by Technical Book Shop, San Francisco. Price, $3.00.

This treatise presents the elements of cost accounting so that any accountant or engineer should be able to adapt it to any job with a minimum of trouble. It deals primarily with manufacturing costs, whether of simple job, departmental or process. Examples are given of the application of principles in typical cases. A careful study should enable any manufacturer to comply with the first commandment of business—"Know thy costs."

"Theoretical Elements of Electrical Engineering," by C. P. Steinmetz; 368 pp., 6x9 in. Published by McGraw-Hill Book Co., New York City, and for sale by Technical Book Shop, San Francisco. Price $3.00.

This fourth edition of Dr. Steinmetz's well known work represents a radical revision and almost a complete rewriting of the text. This book now contains only the most fundamental principles of the general theory and of such special apparatus as synchronous machines, direct current commutating machines, synchronous converters, the alternating current transformer and induction machines. In conformity with the decision of the International Electrical Congress at Turin, the crank diagram of vector representation is used instead of the polar diagram. A knowledge of the calculus is essential to the intelligent study of this treatise.

"Essentials of Electrical Engineering," by J. F. Wilson; 345 pp., 6x9 in. Published by D. Van Nostrand Co., New York, and for sale by Technical Book Shop, San Francisco. Price $2.50.

As is implied by the title this text presents what, in the author's opinion, are the essential things to be known about electrical engineering in general before specializing on any branch in particular. The non-essentials are omitted and most of the mathematical developments are printed in small type appendices in the back of the book. The author is instructor in electrical engineering at the University of Michigan. The book is an excellent one for the use of students studying any branch of engineering as it lays the ground work of the fundamental laws of the electric circuit, both direct and alternating current.

"Wireless Telegraphy," by Dr. J. Zenneck, translated by A. E. Selig; 443 pp., 6x9 in. Published by McGraw-Hill Book Co., and for sale by Technical Book Shop. Price $4.00.

During the five years since Zenneck's book has become a standard to many German speaking engineers, its merits has been inaccessible to many English speaking experimenters. Consequently this excellent translation should be accorded a hearty welcome. It is by no means an elementary treatise, as an understanding of the calculus is essential to its use. It places the subject on a scientific basis and should be indispensable to professional and well educated amateurs. The text is divided into fourteen chapters. The first two deal with oscillations of the condenser circuit, including determination of frequency, methods of damping and a description of the various types of open oscillators. The next two chapters are concerned with circuits, the high frequency a.c. circuit and coupled circuits. Resonance curves are thoroughly discussed and the antenna is described in detail as regards various kinds. Three chapters are devoted to transmitting of damped and undamped oscillaitions, full details being given of the various methods in use. Then follows a theoretical treatment of the propagation of waves, and then chapters on detectors and receivers. The concluding chapters are devoted to directive telegraphy and wireless telephony.

PUBLICATIONS RECEIVED.

Report of the Idaho Public Utilities Commission, Boise, Idaho from July 1, 1914, to June 30, 1915; 406 pp., 6x9 in.; full text of formal applications, general orders and statistics of all utilities in the state.

Bulletin 100, U. S. Bureau of Mines, "Manufacture and Uses of Alloy Steels," by Henry D. Hibbard, gives properties, methods of manufacture and treatment of tungsten, manganese, chromium, nickel and silicon steels.

Bulletin 97, U. S. Bureau of Mines, "Sampling and Analyzing Flue Gases," by Henry Kreisinger and F. K. Ovitz, gives detailed information for engineers in charge of boiler plants as to promoting boiler room economy.

NEW CATALOGUES.

Regent Semi-Indirect Bowls for decorative and commercial lighting are attractively illustrated and described in Catalague No. 108 issued by the Ivanhoe-Regent Works and being sent to interested parties by the Pacific States Electric Company. In addition to beautiful full-page halftones of the various styles in Veluria, Druid and Sudan glass, with accompanying text, this catalogue gives engineering data as to most efficient methods of installation.

The sixth edition of "How to Figure Illumination and a Complete Catalogue of Sunbeam Mazda Lamps" has just been published by the Western Electric Company, Inc. This booklet gives tables and complete illuminating data, as well as picturing and describing the various sizes of Sunbeam Mazda lamps.

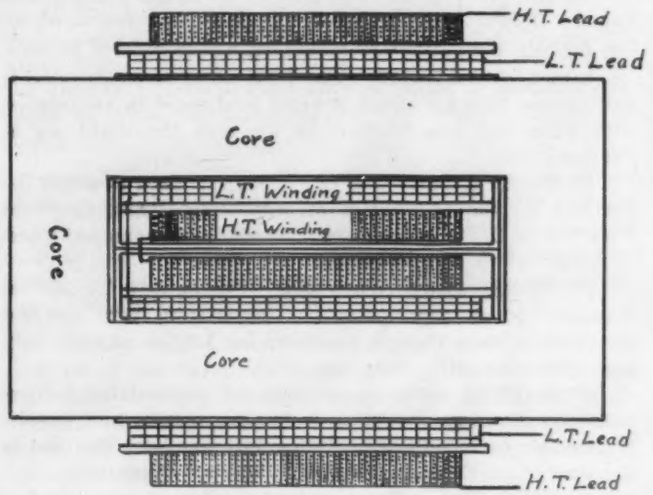
Bulletin 12, dated January, 1916, is the latest piece of literature describing Cutler-Hammer Lifting Magnets. This 24 page bulletin contains over 40 illustrations and interesting information concerning the design, application, cost of handling various materials, etc. A circular describing briefly the Cutler-Hammer Magnetic Separator Pulley is being sent to various industries that have use for this device, including paper and pulp mills, cement plants, gypsum plants, starch mills, foundries, steel plants, mines, glass factories, rubber plants, and others.

INDUSTRIAL

AN IMPROVED METHOD OF WINDING HIGH TENSION TRANSFORMERS.

A method of winding high tension transformers intended to dispense with the necessity of "pies," and greatly reduce the voltage between adjacent wires or parts of windings, has recently been devised by S. M. Gardner, designing engineer for the Western Transformer Company of Oakland, Cal.

In order to keep the voltage between layers and adjacent parts of the windings of high tension transformers down to a safe working basis, the high tension windings are at the present time divided into a great many small coils called "pies" so that the layers will be short, with but few turns per layer. It is considered good practice in the designing of high voltage transformers not to exceed 150 volts between layers or 2000 volts per coil section. If each coil generates 2000 volts, then there will be 40000 volts between the



Winding for High Tension Transformers.

outer edges of adjacent coils. This requires considerable insulation to separate the two in order to withstand safely the continued static stress. Also considerable valuable winding space is taken up by this insulation.

It is mainly this minor insulation which increases the size of high voltage transformers as well as their weight, and decreases their efficiency when compared to the same capacity of lower voltage. The cost of manufacture of high voltage transformers is greatly in excess of that of the lower voltage, this being due partially to the minor insulation just mentioned, partly to the cost of the material and the increased labor.

If instead of winding the high tension coils in layers lengthwise with the central magnetic core they are wound in layers transverse to the core, the layers need not be long, and therefore the voltage between layers is kept very low, without any sub-dividing. There is also little mechanical as well as static stress between layers. In very large transformers, or where the wire is small, an insulating ring of paper may be placed between each layer of wire. Thus the winding is nearly as compact as that for the low voltages. The increase in voltage is gradual from one end to the other of the winding. The winding may be kept thin and need have little or no covering of insulation or tape between it and the surrounding oil for cooling it.

The two leads of the coil can be brought out at the outer edges. The wire is wound with each succeeding turn concentric with the others to the same layer.

Thus these windings should be durable, because of decreased mechanical and static strain between parts of the windings. It should be efficient, because of less material and hence less losses. Be lighter for handling and shipping, cost less to manufacture, have good regulation, because of arrangement of the coils and reduced copper, require less insulating tape and hence radiate the heat better to the oil, and thus operate cooler.

TRADE NOTES.

The sentiment in favor of displaying a U. S. flag by hotels, clubs, theaters, etc., is suggested by the lamp companies as an opportunity for the central station to boost the use of electric flags with colored lamps.

The Western Electric Company is offering $250 in prizes for window displays of fans, using a display cutout furnished by them. Ten prizes are offered and in addition one dollar will be paid for each photograph submitted.

The business of the General Electric Construction Company of San Francisco has been segregated into a retail sales and an electrical contracting department. Geo. A. Sittman continues to act as manager of the General Electric Construction Company, while M. L. Scobey handles the retail department under the name of the Home Electrical.

NePage, McKenny & Company, of Portland, have been awarded a contract to install the electrical equipment on the lift span for the big intrastate bridge spanning the Columbia River at Vancouver, Wash. The work will involve the installation of two 150 horsepower motors. They have also been awarded a contract for the electrical installation in the new Bellingham high school building.

The United States Fuel Ship "Mars" arrived in San Diego the middle of January carrying 150 tons of the government exhibit which will be displayed at the Panama-California International Exposition through the entire year 1916. The government will participate in the 1916 Exposition to as great an extent as in San Francisco. At least a half-dozen bands, and artillery, cavalry, marine and infantry troops will be in the exposition grounds during the year. The scope of the San Diego exposition has been increased so greatly for 1916 that the directors have found it necessary to change the name to read "Panama-California International Exposition." Canada, Russia, France, Italy, Germany, Brazil, The Netherlands and Switzerland, are installing big displays—the greater part of them brought from the San Francisco exposition. Other features of the beautiful exposition have been enlarged so that the dedication of the new exposition, March 15th, is more than a matter of form.

NEW CATALOGUES.

Westinghouse Electric Fans for 1916 are attractively portrayed in Catalogue 8-A from the Westinghouse Electric & Manufacturing Company.

Curtis Steam Turbine Generators are carefully described and beautifully illustrated in Bulletn No. 42,206 from the General Electric Company. The principles of operation are clearly shown and the methods of construction described.

Bulletin No. 44,409 from the railway department of the General Electric Company illustrates and describes ventilated commutating pole railway motors for 240, 600 and 1200 volt operation. Bulletin No. 43,253 from the supply department is devoted to luminous series arc lamps for operation on d.c. circuits of 4, 5 and 6.6 amperes (pendent types). Bulletin No. 47,409 from the switchboard department presents pictures and text regarding small capacity industrial oil switches for 3-phase induction motors of 10 h.p. or less.

NEWS NOTES

FINANCIAL.

SAN FRANCISCO, CAL.—The Great Western Power Company of California has been authorized by the railroad commission to spend the proceeds from the sale of $5,000,000 face value, ten-year 6 per cent convertible gold debentures, practically in accordance with the application of the company. The money from the sale of not over $3,000,000 worth of debentures may be used to buy $4,988,000 face value of the capital stock of the City Electric Company. The money received from the sale of $2,000,000 of debentures may be used to buy from the Western Power Company at not over 90, the following bonds: Eight hundred and forty-nine thousand dollars first mortgage 5 per cent forty-year sinking fund gold bonds of the Great Western Power Company, $1,050,000 of first mortgage 5 per cent thirty-year sinking fund gold bonds of the City Electric Company. A stipulation is made by the commission that the Great Western Power Company of California, before spending any of the money to buy the City Electric stock, shall first secure from the commission an order stating that the Great Western Power Company has agreed that it will use $3,000,000 to be received from the sale of the City Electric Company's stock only after the commission has authorized the expenditures. By previous decisions of the commission the Great Western Power Company of California was directed to use the proceeds from the sale of the $5,000,000 of bonds mentioned for the purchase of the stock of the City Electric Company, as now authorized, and besides $1,500,000 for the construction of two transmission lines from Big Bend to Oakland and $250,000 for two cables across the bay. Later the Great Western Power Company of California asked to apply to the purchase of the bonds of the Great Western Power Company and City Electric Company that portion of the proceeds obtained from the sale of its debentures which heretofore it had agreed to spend for the transmission lines and cables. It was testified that the proposed program had not been abandoned but that part of the $3,000,000 to be paid for City Electric stock will be used for these improvements.

INCORPORATIONS.

VENTURA, CAL.—Articles of incorporation for Conejo Mutual Water Company have been filed. The articles provide for the acquiring of wells, engines and pipe lines to carry water to the property of the stockholders of the company. It is planned to develop the necessary reservoir systems and rights of way. The principal place of business is the ranch of C. E. Utt and Sherman Stevens, seven miles east of Camarillo. The capital stock is $25,000.

BAKERSFIELD, CAL.—The Pacific Light & Power Corporation has filed articles of incorporation in Kern county, with the following seven as a board of directors: Wm. G. Kerkchoff, Kaspare Cohn, Chas. Forman, W. N. Kemp of Los Angeles; George S. Patten and Howard E. Huntington of Pasadena, and H. E. Huntington of Oneota, New York. Capital stock is $40,000,000, with $7000 subscribed, a thousand dollars by each of the named members of the board of directors.

ILLUMINATION.

CENTRALIA, WASH.—The power dam of the Central Light & Power Company was destroyed in the recent high water.

SANTA ANA, CAL.—The bid of the Palmer Motor Company for ornamental lights has been accepted. The cost will be $9920.

SPOKANE, WASH.—The installation of a curb lighting system on Sprague avenue is being asked by property owners on that street.

PROSSER, WASH.—A $12,000 bond issue will soon be put to a vote of the people. The city council is considering the matter of constructing a municipal light plant.

WEISER, IDAHO.—The city council has granted the Weiser Oil & Gas Company a franchise in this city for 50 years. The company will begin at once laying pipes.

ONTARIO, CAL.—The city council has awarded a contract for the installation of an electrolier street lighting system to the Granger-Hall Electric Company of Ontario.

SEATTLE, WASH.—Specifications for 34,000 ft. of cable and wire for the new city hall have been approved by the council. Bids will be called for soon by the purchasing agent.

LA GRANDE, ORE.—The Mill Creek power plant of the Eastern Oregon Light & Power Company was destroyed by fire January 17th. Work of rebuilding will be started at once.

LOS ANGELES, CAL.—The department of public service will receive bids for street lighting equipment in accordance with plans and specifications on file with the board, up to February 15th.

PASADENA, CAL.—The city commission has awarded the contract for the installation of ornamental street lights on a portion of Prospect boulevard, terrace and square, to Chas. C. Glass on his bid of $4890.

PHOENIX, ARIZ.—When bids were opened for the installation of an ornamental lighting system here the bid of the New State Electric Company for $18,055 was the only one complying with the plans.

SAN DIEGO, CAL.—A contract for maintaining festoon lights on Broadway, Fifth and Twelfth streets and supplying electric current therefor during 1916 has been awarded to the San Diego Consolidated Gas & Electric Company.

FRESNO, CAL.—The board of trustees has adopted a resolution of intention for the construction of an electrolier street lighting system upon J street from Merced to Tuolumne streets, and upon Tuolumne street from J to I streets.

LOS ANGELES, CAL.—Specifications for street lighting equipment in the East Los Angeles-Garvanza-Highland Park district and Hollywood and East Hollywood district have been approved by the public service commission. Bids for equipment will be called for at once.

LOS ANGELES, CAL.—A petition has been filed with the board of supervisors asking for the establishment of a highway lighting district to be known as the Graham lighting district of Los Angeles county. A hearing on the petition will be held by the board on February 7th.

EUGENE, ORE.—Cluster lights similar to those on Willamette and Olive streets, will be erected on Eighth avenue E. between Willamette and Pearl streets. The county court has signed a petition for the lights, and it will be presented to the city council at its next meeting. Twelve posts are required.

LOS ANGELES, CAL.—The purchase by Eastern capitalists of the Southern California Edison Company's gas plants at Pomona, Long Beach, Santa Monica, Venice, San Pedro, San Dimas, Lordsburg, Ocean Park and Claremont has been officially announced. The Edison Company's Santa Barbara plant is not included in the deal. The price paid is estimated at from $3,000,000 to $4,000,000. F. R. Bain, president of the Southern Counties Gas Company, is among the principal contributors to the purchase. It is understood the properties will be used in the proposed reorganization and development of the Southern Counties Company from a $2,000,000

to a $10,000,000 corporation, natural gas being used. It is said the Edison Company will give up its gas holdings and become an electrical organization exclusively.

TRANSMISSION.

BOISE, IDAHO.—A certificate of convenience and necessity has been issued to the Southern Idaho Water Power Company to extend its distributing lines to Power and Bingham counties, to furnish electrical energy for light and power.

BAKERSFIELD, CAL.—Contracts for nine electric plants for pumping water in the Weed-Patch district have been signed up by Manager E. A. Farrow of the San Joaquin Light & Power Corporation and extensions of power lines for a distance of 11 miles will be built at once.

CARLSBAD, N. M.—It is estimated the cost of improvements begun by Carlsbad Utilities Company will amount to $20,000. The system is being changed from 2300 volt to 6600 volt, 3-phase. Six transformers, new generator, new motor and pump will be installed.

QUINCY, CAL.—Geo. H. Hall of Taylorsville has applied to the board of supervisors for a franchise to erect an electric power line for the distribution of electricity in Taylorsville and vicinity. The board has ordered notice of intention published to grant the franchise to the highest bidder on March 16th.

SAN BERNARDINO, CAL.—The Pacific Light & Power Company has been granted a franchise to construct and for fifty years to operate an electric pole and wire system, for transmitting electricity for lighting, heating, and power purposes, upon all public highways in San Bernardino county. The ordinance to take effect February 10th.

YREKA, CAL.—Several changes were made in the management of the California-Oregon Power Company following the annual meeting. Officers were elected as follows: J. D. Grant, president; J. D. McKee, Alex. J. Rosborough and Jesse W. Churchill, vice-presidents; I. C. Thompson, secretary; executive committee, Jesse W. Churchill, J. Henry Meyer, J. D. Grant, Alex. J. Rosborough, Joseph Hyman and Joseph A. Donohoe. The corporation is the successor of the Siskiyou Electric Power & Light Company. It supplies 34 communities with light and power in Northern California and Southern Oregon and is building an additional plant on the Klamath River to generate 53,000 h.p.

TELEPHONE AND TELEGRAPH.

PASADENA, CAL.—The city has appropriated $300 to construct a telephone line from Pasadena to patrolmen's headquarters back of Switzer's Camp.

SAN DIEGO, CAL.—An ordinance granting to the Postal Telegraph Company permission to lay wires underground on E and G streets, between Fifth and Sixth streets, has been passed by the council.

WAPATO, Wash.—Residents of White Swan and vicinity are anxious to have a telephone system installed in that locality. Several of the ranchers have stated that if a telephone system is brought to White Swan and a central office established they will bear all expenses of construction.

SANTA BARBARA, CAL.—That negotiations have virtually been concluded for the merging of the two local telephone companies is admitted by E. A. Gilbert, president of the Home company, and by George Bush, until recently assistant general manager at San Francisco of the Pacific Telephone & Telegraph Company, which operates the other system. The lines are to be taken over by a third company, which Bush represents. Those interested in this are said to be San Francisco capitalists.

TRANSPORTATION.

LOS ANGELES, CAL.—The city engineer has approved the plans of the Panama Electric Railway for overhead structures and sheds to be installed over Los Angeles street, at the rear of the company's Sixth street depot.

GLENDALE, CAL.—The board of trustees has granted a franchise to the Pacific Electric Railway for the extension of its line from Glendale avenue eastward to the Child's Tract line and southerly to connect at Tropico with its main line.

RIVERSIDE, CAL.—The Pacific Electric has asked for a franchise across Magnolia avenue just below Myers street at Arlington for the building of a spur track on the southerly side of the avenue to reach the new freight station it proposes to erect there.

SALT LAKE, UTAH.—A franchise asked for by Harry Joseph for the extension of the proposed Jordan-Bingham electric railway through to Midvale has been granted by the county commissioners. The extension as planned is to be from the west side of Jordan River eastward to Midvale.

SAN FRANCISCO, CAL.—The contract for the construction of the Church street Municipal Railway from Sixteenth to Eighteenth and from Twenty-second to Thirtieth streets, has been awarded by the board of public works to the Western Motor Drying Company on its bid of $57,455. The contract for furnishing trolley poles has been given to John Spargo for $6590.

FRESNO, CAL.—It is reported that new capital represented by G. O. Whittemore of Los Angeles has been secured for the Fresno interurban railroad project, and that J. B. Rogers has resigned his position as president. Lee H. Landis, who has been traffic manager of the road, has been promoted to the position of general manager. He has interests in other lines, but will now spend most of his time in Fresno. P. N. McCaffrey will continue in his position as superintendent of construction.

SAN FRANCISCO, CAL.—The city engineer has requested the supervisors for an appropriation of $5000 to enable him to prepare reports on the following proposed Municipal Railway extensions: Potrero avenue line to Hunter's Point, Fifteenth street and Park Hill line, Townsend street line, Sunset District lines and extension of the Stockton street line to Third and Townsend streets. He also intends to report a modified plan for running the Municipal Railway across Golden Gate Park.

WATERWORKS.

POCATELLO, IDAHO.—February 7th is the date set for the hearing on the establishment of a municipal water plant for Pocatello.

GALLUP, N. M.—The city council has taken first steps toward securing an increased water supply. The necessary papers will be drawn up for a bond election for this purpose.

LOVELOCK, NEV.—Lovelock citizens have voted a $90,000 bond issue to bring water to this place from springs in the Humboldt range of mountains. The Humboldt county board of commissioners will appoint a special committee to locate sources of supply and to install a complete water system.

LOS ANGELES, CAL.—The $2,604,000 bond issue for the development of the water and irrigation system of San Fernando Valley was passed a second time by the supervisors last week. A feature of action was a request for a bid on only one-third of the total issue, $868,000. This bid is to be furnished the board not later than February 7th, and each bid is to be accompanied by a certified check for 3 per cent of the total amount. The bonds instead of being dated December 1, 1915, will be dated February 1, 1916. The bidders must offer no less than par, with accrued interest.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

A-1 American Ever-Ready Works of National Carbon Co..
Los Angeles; 755 Folsom St., San Francisco; Seattle.

A-2 Atchison, Topeka & Santa Fe Railway Co.....
673 Market St., San Francisco; 1218 Broadway, Oakland.

B-1 Baker-Joslyn Company..... 3
71 New Montgomery St., San Francisco; 911 Western Ave., Seattle; 353 E. Second St., Los Angeles.

B-2 Benjamin Electric Manufacturing Co.....
590 Howard St., San Francisco.

B-5 Bridgeport Brass Co..... 4
(See Pierson, Roeding & Co.)

B-7 Busch-Sulzer Bros.-Diesel Engine Co.....
Rialto Bldg., San Francisco.

C-1 Century Electric Co..... 4
906 So. Hope St., Los Angeles; 56 Natoma St., San Francisco; 65 Front St., Portland, Ore.

C-3 Crocker-Wheeler Co..... 3
Crossley Bldg., 618 Mission St., San Francisco; 228 Central Avenue, Los Angeles.

C-4 Cutler-Hammer Manufacturing Co..... 13
579 Howard St., San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-4 Davis Slate & Manufacturing Co..... 3
Chicago, Ill.

D-2 Dearborn Drug and Chemical Works..... 11
355 East Second St., Los Angeles; 301 Front St., San Francisco.

E-1 Edison Lamp Works of General Electric Co.....
Rialto Bldg., San Francisco; 724 So. Spring St., Los Angeles.

E-2 Edison Storage Battery Supply Co..... 11
441 Golden Gate Ave., San Francisco.

E-4 Electric Storage Battery Co.....
Pacific Electric Bldg., Los Angeles; Spalding Bldg., Portland; 118 New Montgomery St., San Francisco; Colman Bldg., Seattle.

E-5 Electric, Railway & Manufacturing Supply Co..... 4
34 Second St., San Francisco.

F-1 Fairbanks, Morse & Co..... 3
Los Angeles; Portland; 651 Mission St., San Francisco; Seattle; Spokane.

F-3 Federal Sign System (Electric)..... 5
618 Mission St., San Francisco.

G-1 General Electric Co..... 12
724 So. Spring St., Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.

G-1 General Vehicle Co.....
1117 Van Ness Ave., San Francisco; 331 Wall St., Los Angeles; British Columbia Electric Ry., Ltd., Vancouver, B. C.

H-1 Habirshaw Wire Co.....
(See Western Electric Company.)

H-2 Hemingray Glass Co..... 11
330 So. Los Angeles St., Los Angeles; 345 Oak St., Portland; 807 Mission St., San Francisco.

H-5 Hunt, Mirk & Co.....
141 Second St., San Francisco.

H-7 Hurley Machine Co..... 2
New York and Chicago.

I-1 Indiana Rubber and Insulated Wire Co..... 14
Fobes Supply Co., Portland and Seattle.

L-1 Leahy Manufacturing Co..... 4
Eighth and Alameda St., Los Angeles.

L-2 Locke Insulator Manufacturing Co..... 4
(See Pierson, Roeding & Co.)

M-2 McGlauflin Manufacturing Co..... 11
Sunnyvale, Cal.

M-4 Morse Chain Co.....
Monadnock Bldg., San Francisco.

M-3 Moore & Co., Charles C..... 3
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland; Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson.

N-1 Nason & Co., R. N.....
151 Potrero Ave., San Francisco.

N-6 National Carbon Company..... 14
Cleveland, Ohio.

N-2 National Conduit & Cable Co., The.....
Trust and Savings Bldg., Los Angeles; Rialto Bldg., San Francisco.

N-3 National Lamp Works of G. E. Co.....
(All Jobbers.)

N-4 New York Insulated Wire Co.....
629 Howard St., San Francisco.

N-5 Northwestern Pacific Railroad.....
808 Phelan Bldg., San Francisco.

O-1 Okonite Co. (The)..... 4
(All Jobbers.)

P-1 Pacific Electric Manufacturing Co.....
80 Tehama St., San Francisco.

P-2 Pacific States Electric Co..... 2
236-240 So. Los Angeles St., Los Angeles; 90 Seventh St., Portland; 200-210 Twelfth St., Oakland; 575 Mission St., San Francisco; 307 First Ave. So., Seattle.

P-4 Pelton Water Wheel Co..... 11
2219 Harrison St., San Francisco.

P-5 Pierson, Roeding & Co..... 4
Pacific Electric Bldg., Los Angeles; Rialto Bldg., San Francisco; Colman Bldg., Seattle.

P-7 Pittsburgh Piping & Equipment Co..... 14
Monadnock Bldg., San Francisco.

S-1 Schaw-Batcher Company, Pipe Works, The.....
211 J St., Sacramento; 356 Market St., San Francisco.

S-3 Simplex Electric Heating Co..... 14
612 Howard St., San Francisco.

S-4 Southern Pacific Co.....
Flood Bldg., San Francisco.

S-5 Sprague Electric Works..... 4
Rialto Bldg., San Francisco; Colman Bldg., Seattle; Corporation Bldg., Los Angeles; Electric Bldg., Portland; Paulsen Bldg., Spokane.

S-6 Standard Underground Cable Co.....
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Yeon Bldg., Portland; Central Bldg., Seattle, Wash.

T-1 Thomas & Co., R.....
(See Western Electric Co.)

T-2 Tubular Woven Fabric Company.....
Pawtucket, R I.

W-2 Western Electric Co.....
Eighth and Santee Sts., Los Angeles; 1901 Telegraph Ave., Oakland, Cal.; 680 Folsom St., San Francisco; 907 First Ave., Seattle; 45 North Fifth St., Portland, Ore.

W-4 Westinghouse Electric and Manufacturing Co..... 6
50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; 165 Second St., San Francisco; Second and Cherry Sts., Seattle; Paulsen Bldg., Spokane.

W-5 Westinghouse Machine Co.....
141 Second St., San Francisco.

W-6 Westinghouse Lamp Co.....
(See Westinghouse Electric & Manufacturing Co.)

W-8 Western Pipe & Steel Co.....
444 Market St., San Francisco; 1758 North Broadway, Los Angeles.